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Cropland, Water, and Conservation

Situation and Outlook Report

Harvested Cropland Lowest This Century

INTRODUCTION

Changes in commodity and production input prices, competing uses for land and water, technology, and Federal programs cause adjustments in cropland, water use, and conservation. This report presents information on current trends and the near-term outlook for cropland, water, and soil conservation, and the policies affecting their use. The following terms are used:

Acreage Reduction Programs --a voluntary land retirement program in which farmers reduce their planted acreage to become eligible for deficiency payments, loan programs, and other USDA farm program benefits

0/92 Provision -- an optional, Federal acreage diversion program which provides deficiency payments to wheat and feed grain producers who underplant their permitted acres by more than 8 percent

50/92 Provision --an optional, Federal acreage diversion program which provides deficiency payments to wheat and feed grain producers who underplant their permitted acres by more than 8 percent.

Base acres --for wheat, feedgrain, upland cotton, and rice, the average of acres planted and considered planted to the crop for harvest during the 5 preceding years. When a commodity acreage reduction program is in effect, a farmer's planted acreage cannot exceed the base acres and be eligible for deficiency payments, loan programs, and other USDA program benefits.

Cropland used for crops --cropland harvested, crop failure, and cultivated summer fallow.

Cropland harvested --acreage on which intertilled and closely sown crops, tree fruits, small fruits, planted tree nuts, and hay are harvested.

Crop failure --mainly acreage on which crops failed because of weather, insects, and diseases, but includes some land not harvested due to lack of labor, low market prices, or other factors. Excludes acreage planted to cover and soil improvement crops not intended for harvest.

Cultivated summer fallow --cropland in subhumid regions of the West cultivated for a season or more to control weeds and accumulate moisture before small grains are planted. Other types of fallow, such as cropland planted to soil improvement crops but not harvested and cropland left idle all year, are excluded.

Erosion --the process in which water or wind moves soil from one location to another.

Tolerance (T) value --the maximum rate of annual soil loss in tons per acre per year that will permit crop productivity to be sustained indefinitely.

Erodibility index --a value which combines the soil's inherent erodibility (RKLS from the universal soil loss equation or C1 from the wind erosion equation) with susceptibility to damage by erosion (tolerance or T level). Soils with an erodibility index of eight or greater are deemed highly erodible lands under the Food Security Act of 1985.

Conservation practices --methods or devices which reduce soil erosion or retain soil moisture. Major conservation practices include conservation tillage (defined below), cropping or rotation systems, contour farming, strip-cropping, terraces, diversions, and grassed waterways.

Conservation tillage --any tillage and planting system that maintains at least 30 percent of the soil surface covered by crop residue after planting to reduce soil erosion by water; or where soil erosion by wind is the primary concern, any system that maintains at least 1,000 pounds of flat small grain residue equivalent on the surface during the critical erosion period. No-till is the most restrictive or soil conserving form of conservation tillage. Other conservation tillage practices include ridge-till, strip-till, and mulch-till.

Conventional tillage --tillage that inverts the soil by plowing or which otherwise leaves less than the minimum residue after planting required to qualify as conservation tillage.

Irrigated farms --farms with any agricultural land irrigated in the specific calendar year. The acreage irrigated may vary from a very small portion of the total acreage in the farm to irrigation of all agricultural land in the farm.

Irrigable land --Land currently not irrigated but either has project works constructed by the Bureau of Reclamation and available water, or the Bureau of Reclamation has existing plans to provide water.

Acre foot --the quantity of water required to cover 1 acre to a depth of 1 foot. This is equivalent to 43,560 cubic feet or 325,851 gallons.

Acres irrigated --acreage of agricultural land to which water is artificially applied by controlled means. Land flooded during high water periods is included as irrigated land only if the water is diverted to the land by dams, canals, or other works.

Dryland farming --the practice of crop production in low rainfall areas without irrigation by using moisture-conserving techniques, such as mulches and fallowing; also called dry farming.

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SUMMARY

Record acreage idled under Government programs and high crop failure this year will likely result in the lowest harvested crop acreage this century. Farmers idled more than 78 million acres under Federal programs, up 3 million (4 percent) from last year and matching the 1983 record. Crop failure, mainly from widespread drought, is expected to cause farmers to abandon harvest on more than 14 million acres, twice the normal rate of crop failure in recent years. Harvested cropland is estimated at about 284 million acres, down 9 million (3 percent) from last year but 67 million below the 1981 peak.

Crop failure represents an estimated 4.8 percent of 1988 planted acreage and is well above the failure experienced in 1986 and other recent drought years. The drought's full impact on yields and harvested acreage will become more evident as harvesting proceeds. While well above normal for recent years, crop failure is substantially below that which occurred in the drought years in the 1930's when crop failure in one year reached 64 million acres.

This year's cropland used for crops--harvested, failed, and summer fallowed--continues a downward trend from a 1981 peak when no cropland was idled under Federal programs. Cropland used for 1988 crops is estimated at 328 million acres, down 3 million from last year and down 59 million from 1981. In 1989, crop acreage is likely to increase as producers idle fewer acres under Federal programs in anticipation of declining stocks and higher commodity prices.

Of the 78 million acres idled this year, about 54 million were in annual acreage reduction programs, while the remainder was enrolled in the Conservation Reserve Program (CRP) and converted to long-term conservation uses. Farmers found the annual programs to be less attractive this year and participation declined nearly 6 million acres from 1987.

Acreage used for crops shifted slightly toward the Corn Belt and Delta regions this year. The largest reductions occurred in the Mountain (6 percent), Pacific (4 percent), and Northern Plains (3 percent) regions. The changes are related to regional changes in acres idled through Federal programs.

Soil conservation continues to reduce erosion and improve water quality as more conservation practices are used and highly erodible land is converted to long-term conserving uses. Counting 1.3 million acres not scheduled for retirement until 1989, total enrollment in the CRP through February was 25.5 million acres. The establishment of permanent vegetative cover on this land is expected to reduce average annual erosion by 21 tons per acre. Additional acreage was offered for enrollment during an August sign up period. Annual cropland erosion prevented by newly applied conservation treatments and idling of cropland under the CRP and other Federal programs in 1988 could total 350 million tons.

In 1988, public and private expenditures for land and water conservation could total $3.8 billion, up from $2.9 billion in 1987. Most of the increase is for soil erosion control and includes $1.2 billion for CRP rental payments and associated cost sharing to establish permanent vegetative cover. The CRP rental payments average just over $48 per acre. To encourage increased enrollment in the CRP, maximum acceptable rental rates for the CRP were raised in some areas. Rules also were modified to make additional land planted to trees and buffer strips along streams and lakes eligible for the program.

Irrigated acreage normally contributes about 30 percent to the total value of crop production in the United States and is expected to contribute an even larger share this year as drought lowers production in nonirrigated areas. An estimated 48 million acres are irrigated this year, up 2 million from 1987. The arid Pacific and Mountain regions account for over half (26 million acres) of the irrigated acreage, while the Northern and Southern Plains contain an additional 30 percent (14 million acres).

Favorable economic conditions and water policies generally resulted in a gradual expansion of irrigated acreage through the 1970's. Commodity programs, energy prices, public irrigation development, irrigation technology, water supplies, and drought have recently have caused regional fluctuations in irrigated acres. There is a general eastern drift in the adoption of irrigation. This year's 2 million additional irrigated acres appear to be more the return to service of previously idled equipment than newly irrigated land. This is most evident in the Southern Plains where high pumping costs and declining commodity prices had caused some irrigators to shift to dryland production.

1988/89 OUTLOOK

Cropland used for crops in 1989 likely will rebound from the 1988 low of 328 million acres. U.S. agricultural exports have been increasing, stocks of many crops are down, and 1988 production is down due to the drought. All of these factors should boost U.S. market prices. With slightly lower target prices for program commodities in 1989, participation in the 1989 commodity programs is expected to decline from 1988, although it likely will remain high as many producers continue to rely on deficiency payments to supplement their returns from production. Additional enrollments in the CRP, however, will continue to take land out of production.

Several provisions of the 1989 wheat program have been announced. Participants must idle 10 percent of their base acreage, compared to 27.5 percent in 1988, while the target price will be $4.10 per bushel, down 3 percent from this year. The 1989 loan rate for wheat has been lowered 7 percent to $2.06 per bushel. Provisions of the feed grain and upland cotton programs must be announced by September 30 and November 1, respectively.

Effects of the 1988 drought could persist into next year's planting season. Lower levels of crop residue and soil moisture will make affected areas more vulnerable to sheet and rill erosion when rain does occur and could particularly increase wind erosion. Irrigation is likely to increase where water supplies and unused equipment are available to supplement the depleted soil moisture. However, water supplies from reservoirs used to irrigate much of the northern and western United States may not return to normal levels by next growing season.

Conservation tillage use should increase in 1989 with the expected rebound in cropland used for major crops and as farmers begin adopting conservation tillage on highly erodible land to achieve compliance. Under the conservation compliance provision of the 1985 Food Security Act, farm owners or operators must have an approved conservation plan for highly erodible land by January 1, 1990, and complete implementation of the plan by 1995 to retain eligibility for USDA program benefits.

CROPLAND

Downward Trend in Acreage Continues

About 328 million acres are expected to be used for crops in 1988, down 3 million (1 percent) from last year (table 1). Crop acreage has been trending downward since peaking at 387 million in 1981 when no acreage was idled under Federal programs. The subsequent decline has been mainly due to increased farmer participation in Federal programs aimed at limiting crop production or soil erosion. Farmers idled a record 78.4 million acres in 1988, 3 million more than in 1987 and slightly above the previous high of 78.0

Figure 1
Major Uses of U.S. Cropland

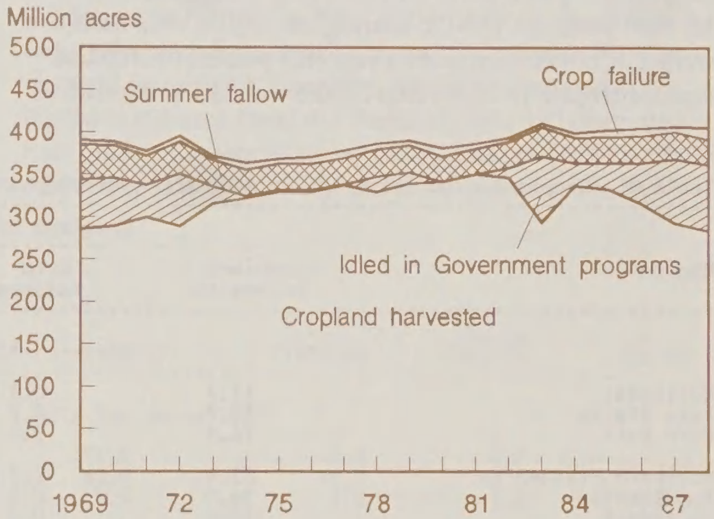


Table 1.--Major uses of cropland, United States 1/

Cropland use	1969	1974	1978	1982	1984	1986	1987	1988 2/
	Million acres							
Cropland used for crops	333	361	369	383	373	357	331	328
Cropland harvested	286	322	330	347	337	316	293	284
Crop failure	6	8	7	5	6	9	6	14
Cultivated summer fallow	41	31	32	31	30	32	32	30
Cropland idled by all Government programs	58	3	18	11	27	48	76	78
Annual programs	50	0	18	11	27	46	60	54
Long term programs	8	3	0	0	0	2	16	24
Total, specified uses 3/	391	364	387	394	400	405	407	406

1/ Includes the 48 conterminous States. 2/ Preliminary. 3/ Does not include cropland pasture or idle land not in government programs normally included in the total cropland base.

million acres idled under the payment-in-kind (PIK) program in 1983 (fig. 1). This year's record resulted from land idled by the Conservation Reserve Program in addition to annual acreage reduction programs.

Farmers intend to harvest 282 million acres of the 19 principal crops, which together with minor crops may bring total harvested acres in 1988 to more than 294 million. With nearly 10 million acres estimated to be double cropped, harvested cropland is expected to total 284 million acres, 9 million below last year and 67 million below the 1981 record. Because harvesting is still underway in many areas, these estimates may change.

Nearly 30 million acres were placed in summer fallow in 1988, down more than 2 million from 1987. Extreme drought in many farm production regions has contributed to crop failure estimated at more than 14 million acres, 4.8 percent of the planted acreage. Crop failure is up more than 60 percent from 1986 when drought also hit several regions, particularly the Southeast and Southern Plains, and is about double the average over the last 20 years. Although high this year compared to recent years, crop failure was higher in the 1950's and the 1930's. During the 1930's, crop failure averaged 25.8 million acres a year (6.8 percent of cropland used for crops). In 1934, crop failure was 63.7 million acres (17 percent of cropland used for crops). The impacts of the drought on harvested acreage and crop yields in 1988 will become more evident as harvesting proceeds.

Corn Belt Farmers Use 4 Million More Acres

Cropland used for crops in 1988 is higher in the Corn Belt, Delta States, and Southeast, and lower in all other regions, particularly the Northern Plains and Mountain region, than last year. Cropland in the Corn Belt is expected to total 77.9 million acres, more than 4 million (6 percent) above 1987 (table 2, fig 2). While sharply higher in 1988, Corn Belt acreage is still less than in most recent years except 1983.

A part of the Corn Belt acreage increase was accounted for by additional acres in corn (0.6 million) and wheat (1.3 million). Corn Belt farmers idled 1.2 million fewer acres under Federal programs this year than in 1987. Hay harvesting from land idled under government programs, authorized as a result of the drought, also contributed to the increase in crop acreage. Estimated acreage of "other" hay (i.e., hay other than alfalfa and alfalfa mixtures) harvested in 1988 increased by 1.8 million acres in the Corn Belt. Increases of 1.5 million acres in the Northern Plains and 1.2 million acres

Table 2.--Cropland used for crops in 1988 and 1987-88 change, by region

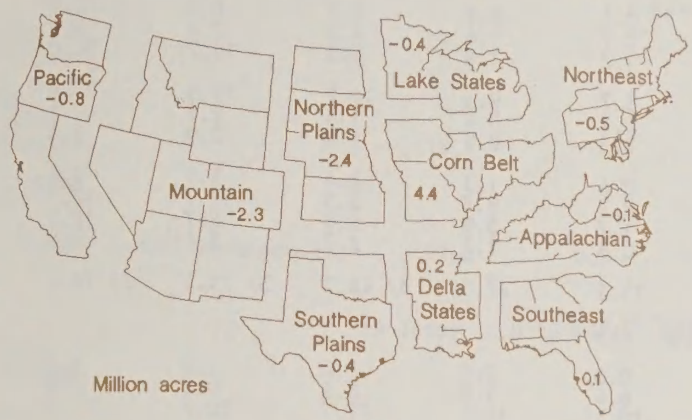
Region	Cropland used for crops 1/: Cropland harvested	Crop failure	Summer fallow	Total	Share of all cropland used for crops
	Million acres				Percent
Northeast	11.7	0.1	-	11.8	3.6
Lake States	30.7	2.2	-	32.9	10.0
Corn Belt	74.9	3.0	-	77.9	23.7
Northern Plains	63.4	5.2	16.0	84.6	25.8
Appalachian	16.0	0.2	-	16.2	4.9
Southeast	10.2	0.2	-	10.4	3.2
Delta States	15.0	0.4	-	15.4	4.7
Southern Plains	24.2	1.7	1.9	27.8	8.5
Mountain	22.8	1.3	9.5	33.6	10.2
Pacific	15.0	0.2	2.4	17.6	5.4
United States 2/	283.9	14.5	29.8	328.2	100.0
	1987-88 change				
Northeast	-0.5	0.0	-	-0.5	
Lake States	-2.2	1.8	-	-0.4	
Corn Belt	2.0	2.4	-	4.4	
Northern Plains	-5.5	4.0	-0.9	-2.4	
Appalachian	-0.1	0.0	-	-0.1	
Southeast	0.1	0.0	-	0.1	
Delta States	0.0	0.2	-	0.2	
Southern Plains	-0.6	0.0	0.2	-0.4	
Mountain	-1.9	0.4	-0.8	-2.3	
Pacific	-0.3	0.1	-0.6	-0.8	
United States 2/	-9.0	8.9	-2.1	-2.2	

- = None or fewer than 100,000 acres.

1/ Preliminary. Based on farmers' intentions to harvest. 2/ Includes the 48 conterminous States. Fewer than 200,000 acres were used for crops in Alaska and Hawaii.

Figure 2

Corn Belt Has Largest 1987-88 Increase in Cropland Used For Crops



Mountain region. These decreases result from more acres idled by Government programs and fewer acres summer fallowed. Reductions in other regions range from 100,000 acres in the Appalachian region to about 800,000 in the Pacific region. Cropland acreages in the Southern Plains, Mountain, and Pacific regions were at their lowest levels in 40 years.

in the Lake States were also noted, as well as minor increases in other regions.[1]

Cropland is down 2.4 million acres (3 percent) in the Northern Plains and 2.3 million acres (6 percent) in the

[1] Some adjustments were made for the estimated harvest of hay from idled acres in estimating cropland used for crops and crop failure. However, accuracte estimates must wait for summary information on the actual extent of hay harvest from idled acres.

Corn Belt, Southeast, and Delta Regions Increase their Shares

The Corn Belt's share of the Nation's cropland increased from about 22 percent in 1987 to nearly 24 percent in 1988. The 1987-88 increase continues a trend during most of the 1980's (table 3). The increase in regional shares in the Southeast and Delta States, although slight, reverses a trend during most of the 1980's. The Northern Plain's share in 1988 is down from 1987 but higher than in many earlier years in the 1980's.

During 1980-87, regional shares of cropland used for crops have shifted from southern regions--the Southeast, Delta States, and Southern Plains--to the Northern Plains and the Mountain region. In 1988, regional shares in all regions except the Corn Belt, Southeast, and Delta States were unchanged or declined. The sharp decline in cropland in the Northern Plains, a trend that began in 1984 and continued into 1988 as farmers idled more cropland, tended to increase other regional shares. Cropland in the Northern Plains

Table 3.--Cropland used for crops and change in acreage, by region

Region	1982	1984	1986	1988 1/	Change 1982-84	Change 1984-86	Change 1986-88
				Million acres			
Northeast	13.6	13.3	12.8	11.8	-0.3	-0.5	-1.0
Lake States	39.8	39.3	36.8	32.9	-0.5	-2.5	-3.9
Corn Belt	86.5	84.9	81.3	77.9	-1.6	-3.6	-3.4
Northern Plains	93.7	92.6	91.1	84.6	-1.1	-1.5	-6.5
Appalachian	19.3	18.6	17.4	16.2	-0.7	-1.2	-1.2
Southeast	14.7	14.3	11.6	10.4	-0.4	-2.7	-1.2
Delta States	19.2	18.4	16.1	15.4	-0.8	-2.3	-0.7
Southern Plains	36.9	32.7	32.1	27.8	-4.2	-0.6	-4.3
Mountain	37.4	38.5	37.7	33.6	1.1	-0.8	-4.1
Pacific	21.5	20.9	19.9	17.6	-0.6	-1.0	-2.3
United States 2/	382.6	373.5	356.8	328.2	-9.1	-16.7	-28.6
				Percent share of U.S. total			
Northeast	3.6	3.6	3.6	3.6	3.3	3.0	3.5
Lake States	10.4	10.5	10.3	10.0	5.5	15.0	13.7
Corn Belt	22.6	22.7	22.8	23.7	17.6	21.5	11.9
Northern Plains	24.5	24.8	25.5	25.8	12.1	9.0	22.7
Appalachian	5.0	5.0	4.9	4.9	7.7	7.2	4.2
Southeast	3.8	3.8	3.3	3.2	4.4	16.1	4.2
Delta States	5.0	4.9	4.5	4.7	8.8	13.8	2.4
Southern Plains	9.7	8.8	9.0	8.5	46.1	3.6	15.1
Mountain	9.8	10.3	10.5	10.2	-12.1	4.8	14.3
Pacific	5.6	5.6	5.6	5.4	6.6	6.0	8.0
United States 2/	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Preliminary. 2/ Includes the 48 conterminous States. Fewer than 200,000 acres were used for crops in Alaska and Hawaii.

Table 4.--Cropland idled under Federal acreage reduction programs, by region

Region	1969	1974	1978	1982	1984	1986	1987	1988
				Million acres				
Northeast	1.5	0.1	0.2	0.1	0.1	0.5	0.9	0.9
Lake States	6.4	0.5	1.6	0.7	1.6	4.0	7.0	6.9
Corn Belt	13.0	0.2	2.8	1.2	2.8	8.5	15.2	14.0
Northern Plains	15.4	0.6	6.9	3.7	9.5	14.2	19.5	21.0
Appalachian	3.5	0.1	0.3	0.1	0.4	1.3	2.7	3.1
Southeast	3.7	0.3	0.3	0.2	0.5	1.3	2.9	3.4
Delta States	1.0	1/	0.2	0.6	1.3	2.4	3.5	3.1
Southern Plains	7.9	0.5	3.4	2.3	5.7	8.3	11.7	12.1
Mountain	4.4	0.4	2.1	1.7	3.9	5.4	8.7	10.1
Pacific	1.2	1/	0.5	0.6	1.2	2.2	3.4	3.8
United States 2/	58.0	2.7	18.3	11.1	27.0	3/ 48.1	3/ 75.5	3/ 78.4
				Percent share of U.S. total 4/				
Northeast	2.6	3.6	1.1	0.6	0.4	1.0	1.2	1.1
Lake States	11.0	18.1	8.9	6.4	5.8	8.3	9.3	8.8
Corn Belt	22.4	7.3	15.2	10.5	10.5	17.7	20.2	17.9
Northern Plains	26.6	21.8	38.2	33.3	35.1	29.5	25.8	26.8
Appalachian	6.1	3.6	1.5	1.2	1.3	2.7	3.6	4.0
Southeast	6.3	10.9	1.7	1.4	1.9	2.7	3.8	4.3
Delta States	1.7	1.4	1.0	5.2	4.8	5.0	4.6	4.0
Southern Plains	13.6	18.2	18.5	21.1	21.2	17.3	15.5	15.4
Mountain	7.6	14.5	11.4	15.1	14.3	11.2	11.5	12.9
Pacific	2.1	0.6	2.5	5.2	4.7	4.6	4.5	4.8
United States 2/	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

1/ Less than 50,000 acres. 2/ Includes the 48 conterminous States. Because of rounding, regional data may not sum to U.S. totals. 3/ Includes cropland idled by 0/92 and 50/92 programs. Also includes 2.0 million acres enrolled in the Conservation Reserve Program in 1986, 15.7 million acres enrolled in 1987, and 24.2 million acres enrolled in 1988. 4/ Developed from unrounded estimates.

declined 2.4 million acres, but the region still has more than 25 percent of the Nation's cropland, down less than 1 percentage point from 1987. The decline of 2.3 million acres in the Mountain region resulted in a decline in regional share of 0.7 percentage point. Other regional shares were about the same as in 1987.

Changes in regional shares are closely related to acres idled and the subsequent number of previously idled acres returned to production as commodity programs change over time. Acreage changes by nonparticipants in Federal programs also vary among regions.

During 1986-88, acreage idled under Federal programs in the Lake States increased 2.9 million (table 4) and cropland used for crops declined 3.9 million acres (table 3). This reverses a relationship that existed earlier in the 1980's where the decrease in cropland was typically less than the increase in idled acres. During 1986-88, the Corn Belt, Northern Plains, Appalachian, Southeast, and Mountain regions had smaller decreases in cropland than increases in idled acres. Cropland decreases were greatest relative to increases in idled land in the Southern Plains, Lake States, Pacific, and Northeast regions, respectively. The decrease in cropland acreage in the Delta States was exactly offset by the increase in idled land.

Idled Acreage at Record High

The record 78.4 million cropland acres idled under Federal programs this year (table 4) includes lands idled under annual cropland reduction programs (including the 0/92 and 50/92 programs) and land contracted in the CRP through the February 1988 sign up. The total excludes land to be idled in the 1989 crop year.

About 82 percent--54.2 million acres--of the 1988 idled acreage is in annual Federal acreage reduction programs, while the remaining 24.2 million acres are enrolled in the CRP. An additional 1.3 million acres scheduled for retirement in 1989 were enrolled in the February 1988 sign up. Results of the August 1988 CRP sign up are not yet available.

Acreage idled by all annual programs declined nearly 6 million for all program crops from 1987 to 1988 (table 5). However, base acreage idled by the CRP in 1988 was nearly offsetting, resulting in a net decrease of only 200,000 acres in total base acreage idled in 1988 from a year earlier. (The difference between the totals in tables 4 and 5 represents nonbase acres idled by the CRP in 1986-88 and by other long-term land retirement programs in 1969 and 1974). Base acreage idled by the CRP remains in effect for the full 10-year life of the CRP contract.

A comparison of the net change in base acres of individual crops idled by annual programs and the CRP in

Table 5.--Base acreage idled under Federal acreage reduction programs, United States

Crop	1969	1974	1978	1982	1984	1986	1987	1988
					Million acres			
					Base acreage idled under annual programs			
Corn	27.2		6.1	2.1	3.9	14.3	23.0	20.9
Sorghum	7.5		1.4	0.7	0.6	2.8	4.0	4.1
Barley	4.4		0.8	0.4	0.5	2.0	2.9	2.9
Oats				0.1	0.1	0.5	0.8	0.3
Wheat	11.1		9.6	5.8	18.6	21.0	23.8	22.8
Cotton			0.3	1.6	2.5	4.1	3.8	2.1
Rice				0.4	0.8	1.5	1.6	1.1
Total, annual programs 1/	50.2	0.0	18.3	11.1	27.0	46.1	59.8	54.2
					Base acreage idled under the Conservation Reserve Program 2/			
Corn						0.1	2.3	2.8
Sorghum						0.2	1.2	1.8
Barley						0.1	1.1	1.9
Oats						0.1	0.5	0.9
Wheat						0.6	4.2	7.1
Cotton						0.1	0.7	1.0
Rice						3/	3/	3/
Total, Conservation Reserve Program 1/						1.2	10.0	15.5
Total base acres idled 1/	50.2	0.0	18.3	11.1	27.0	47.3	69.8	69.6

1/ Because of rounding, crop acreages may not sum to the totals. Base acreages idled under 0/92 and 50/92 programs for 1986, 1987, and 1988 are included in the annual programs data. 2/ Small acreages of peanut and tobacco base were also bid into the Conservation Reserve Program in addition to the crops listed. 3/ Less than 50,000 acres.

1987 and 1988 reveals some major shifts among crops. Net corn base acreage idled declined 1.6 million acres, cotton declined 1.4 million, rice declined 0.5 million, and oats declined 0.1 million. Net wheat base acreage idled increased 1.9 million acres, barley increased 0.8 million, and sorghum increased 0.7 million.

Participants in the 1988 feed grain programs were required to idle at least 20 percent of their base acreages of corn, sorghum, and barley, the same as in 1986 and 1987. Feed grain producers could idle another 10 percent of their base acreage in the Paid Land Diversion Program. The 1988 oats program required idling only 5 percent of the base acreage. Feed grain acreage idled in the 1988 program totals just over 28 million, down slightly from last year. An additional 7.4 million acres has been enrolled in the CRP, about 6 percent of the 1988 feed grain base acreage of nearly 121 million acres.

For wheat, participating growers had to idle 27.5 percent of their base acreage, the same as in 1987. A total of 22.8 million acres was idled, down 1 million from last year. Also, 7.1 million acres (8 percent of the 1988 base acreage) were enrolled in the CRP for 1988.

For cotton, the 1988 acreage reduction requirement was 12.5 percent--half the 1987 requirement. For rice, 25 percent of base had to be idled, compared with 35 percent in 1987. A total of 2.1 million acres of cotton and 1.1 million acres of rice were idled in 1988, down 1.7 and 0.5 million, respectively, from 1987. As of the February 1988 sign up, just 1.0 million cotton base acres and 4,400 rice base acres have been enrolled in the CRP for 1988.

Between 1987 and 1988, total idled acreage was unchanged in the Northeast; decreased in the Lake States, Corn Belt, and Delta States; and increased in all other regions (table 4). Proportionately, the largest increase occurred in the Mountain region where idled acreage was 16 percent higher. Most of the increase was accounted for by an additional 1.7 million acres enrolled in the CRP.

Cropland idled in the Northern Plains increased 1.4 million acres, up 7 percent from 1987. As in the Mountain region, the increase occurred when an additional 2.8 million acres in the CRP more than offset a decline of 1.4 million acres set aside under annual programs. Participation in annual crop programs generally declined as enrollment in the CRP increased in all regions. This is indicated by the 5.7-million-acre reduction in base acreage idled by annual programs from 1987 to 1988 (table 5). Only sorghum had more base acres idled under annual programs in 1988 than in 1987.

CRP enrollments in February 1988 followed last year's pattern of regional increases, with the Plains regions jointly accounting for about 49 percent of the 8.5-million-acre national increase, the Mountain region for about 20 percent, and the Corn Belt for 10 percent. Shares in other regions ranged from 0.6 percent in the Northeast to 6.5 percent in the Lake States.

In recent years, acreage reduction programs have become more effective in reducing the acreage actually cropped. From 1981 to 1983, an additional 78 million acres were idled nationally, but cropland used for crops was down only 54 million acres. When 47 million fewer acres were idled between 1983 and 1985, crop acreage expanded by only 39 million. In 1986, an additional 15 million acres were idled and crop acreage was down just over 15 million from 1985. Similarly, idled acreage increased 27 million during 1986-87 while crop acreage was off nearly 27 million. In 1988, idled acreage was up just 2.9 million acres from 1987 and cropland decreased by 2.2 million acres.

Changes in Crop Acreages Mixed in 1988

Harvested acreages of corn, wheat, and sorghum are expected to be lower in 1988, while acreages of soybeans and cotton are estimated to increase slightly (table 6). In total, all cropland harvested is expected to be down 9 million acres from a year earlier (table 7). Part of the decrease can be explained by increased crop failure, especially in the Northern Plains (up 4.0 million acres), Corn Belt (up 2.4 million acres) and Lake States (up 1.8 million acres)(table 2). These three regions account for over 90 percent of the 1988 increase in estimated crop failure. Crop failure was also estimated to be higher in the Mountain, Delta States, and Pacific regions than in 1987.

Harvested corn acreage in 1988 is forecast at 56.8 million, down 2.4 million from 1987. A large decrease is likely in the Lake States (1.9 million acres) with much smaller decreases likely in the Northern Plains, Appalachian, Northeast, Southeast, and Delta States. Harvested acres are expected to increase substantially in the Corn Belt (0.6 million acres) with a small increase in the Mountain region. Corn harvested acreage in the Southern Plains and Pacific regions is forecast to be unchanged from last year. As fewer acres of corn base were idled this year, the harvested acreage will be due principally to higher crop failure.

Wheat acreage harvested in 1988 is estimated at 52.9 million acres, 3 million less than a year ago. The expected reduction results from an increase of 1.9 million acres of wheat base idled and from the 1988 drought. Considerable crop failure, particularly spring wheat, is estimated in the Northern Plains, where harvested acreage is down sharply. Harvested wheat acreage is also down in the Lake States and the Western regions. Acreage is up in the Corn Belt (nearly 42 percent) as well as in the other Eastern regions.

Sorghum acres harvested for grain in 1988 are estimated at 9 million, down 1.6 million from 1987. Harvested area will be particularly smaller in the Southern Plains where acreage is off more than 19 percent. It appears that some sorghum acreage may have been shifted to cotton, as cotton in the Southern Plains increased 0.7 million acres (nearly 15 percent) from 1987 to 1988. Also, farmers idled 0.7 million more acres of sorghum base in 1988 than last year, including 0.6 million more acres in the 1988 CRP.

Soybeans are expected to be harvested on 56.8 million acres in 1988, about 0.4 million more than in 1987. Acreage is down 0.8 million in the Corn Belt and 0.2 million in the Delta but is up in the other regions normally reporting soybean production. The reduction in soybean acreage in the Corn Belt was offset by increased corn plantings.

Harvested acreage of cotton is expected to be 11.7 million in 1988, up 1.7 million from 1987. Annual cotton program participation, however, decreased 1.7 million acres. The decrease in participation was partially offset by 0.3 million more acres of cotton base enrolled in the CRP for the 1988 crop year. Apparently, nonparticipating cotton producers increased their plantings. Harvested acreage is likely to be as high or higher in all regions that normally report cotton, particularly the Southern Plains and Delta States.

Table 6.--Harvested acreage of major crops, by region 1/

Region	Corn			Sorghum			Wheat			Soybeans			Cotton		
	1982	1987	1988	1982	1987	1988	1982	1987	1988	1982	1987	1988	1982	1987	1988
	Million acres														
Northeast	3.0	2.3	2.1	-	-	-	0.6	0.5	0.5	1.0	0.9	1.0	-	-	-
Lake States	12.7	9.8	7.9	-	-	-	3.9	3.0	2.8	6.3	6.0	6.3	-	-	-
Corn Belt	36.9	29.0	29.6	1.0	0.8	0.5	6.1	3.1	4.4	32.1	29.4	28.6	0.2	0.2	0.2
Northern Plains	11.3	10.6	10.3	5.4	5.3	4.8	30.2	24.5	21.4	5.3	6.3	6.7	-	-	-
Appalachian	4.4	3.2	2.9	0.2	0.2	0.1	2.6	1.3	1.5	6.8	4.1	4.3	0.3	0.5	0.7
Southeast	1.8	1.3	1.1	0.2	0.1	0.1	2.8	1.0	1.1	7.0	2.1	2.3	0.6	0.7	0.9
Delta States	0.2	0.5	0.3	0.5	0.7	0.6	3.3	1.4	1.8	11.1	7.2	7.0	2.1	2.2	2.5
Southern Plains	1.2	1.3	1.3	6.1	3.1	2.5	12.9	8.4	7.9	1.2	0.4	0.6	4.7	4.8	5.5
Mountain	1.1	0.9	1.0	0.7	0.4	0.4	11.2	9.3	8.2	-	-	-	0.6	0.5	0.6
Pacific	0.6	0.3	0.3	0.1	-	-	5.2	3.4	3.3	-	-	-	1.4	1.1	1.3
United States 2/	73.2	59.2	56.8	14.2	10.6	9.0	78.8	55.9	52.9	70.8	56.4	56.8	9.9	10.0	11.7

- = None or fewer than 500,000 acres.

1/ Corn and sorghum for grain. All 1988 acreages based on farmers' intentions to harvest. 2/ Includes the 48 conterminous States.

Table 7.--Change in harvested acreage of major crops 1982-88 and 1987-88, by region 1/

Region	1982-88						1987-88					
	Corn	Sorghum	Wheat	Soybeans	Cotton	All cropland harvested	Corn	Sorghum	Wheat	Soybeans	Cotton	All cropland harvested
	Million acres											
Northeast	-0.9	-	-0.1	0.0	-	-1.8	-0.2	-	0.0	0.1	-	-0.5
Lake States	-4.8	-	-1.1	0.0	-	-8.8	-1.9	-	-0.2	0.3	-	-2.2
Corn Belt	-7.3	-0.5	-1.7	-3.5	0.0	-10.9	0.6	-0.3	1.3	-0.8	0.0	2.0
Northern Plains	-1.0	-0.6	-8.8	1.4	-	-14.2	-0.3	-0.5	-3.1	0.4	-	-5.5
Appalachian	-1.5	0.0	-1.1	-2.5	0.4	-3.2	-0.3	-0.1	0.2	0.2	0.2	-0.1
Southeast	-0.7	-0.1	-1.7	-4.7	0.3	-4.3	-0.2	0.0	0.1	0.2	0.2	0.1
Delta States	0.1	0.1	-1.5	-4.1	0.4	-4.0	-0.2	-0.1	0.4	-0.2	0.3	0.0
Southern Plains	0.1	-3.6	-5.0	-0.6	0.8	-8.6	0.0	-0.6	-0.5	0.2	0.7	-0.6
Mountain	-0.1	-0.3	-3.0	-	0.0	-4.1	0.1	0.0	-1.1	-	0.1	-1.9
Pacific	-0.3	-0.1	-1.9	-	-0.1	-2.9	0.0	-	-0.1	-	0.2	-0.3
United States 2/	-16.4	-5.1	-25.9	-14.0	1.8	-62.8	-2.4	-1.6	-3.0	0.4	1.7	-9.0

- = None or fewer than 100,000 acres.

1/ Corn and sorghum for grain. All 1988 acreages based on farmers' intentions to harvest. 2/ Includes the 48 conterminous States.

Crop Production Per Acre Up in 1987

The U.S. index of crop production per acre was a record 122 (1977=100) in 1987, up from 116 in 1986 and above the previous high of 120 in 1985 (table 8). Seven of the ten farm production regions experienced increases, some quite substantial. The Southern Plains registered a 26-percent rise and three other regions had increases over 10 percent: Delta States (15 percent), Southeast (15), and Pacific (14). Only three regions reported modest declines: Northern Plains (-3 percent), Northeast (-2), and Corn Belt (-2).

In 1987, crop production per acre of cropland used for crops rose to all time highs in six regions: Southeast, Lake States, Delta States, Southern Plains, Mountain, and Pacific.

Acreage Equivalent of Exports Continues To Increase

Exports of U.S. agricultural products in fiscal 1988 are forecast at just over 145 million tons, nearly 13 percent above a year earlier with grains accounting for most of the increase. A recent 3-million-ton increase in the forecast resulted primarily from improved prospects for exports of feed ingredients, soybeans, and wheat. A lower valued U.S. dollar, lower U.S. loan rates, generic certificates, the Export Enhancement Program, and the CCC export credit guarantee program have increased U.S. competitiveness in world markets. The Targeted Export Assistance Program further helps U.S. agricultural exports. Higher demand for feed grains in several importing countries together with reduced export stocks among major U.S. competitors have also improved the U.S. position.

The acreage equivalent of 1987 exports is estimated at 107 million, up more than 11 percent from 96 million acres in 1986 (table 9). The 1987 level, however, is substantially below the high of 137 million estimated in 1980.

Acreage equivalents are estimated by dividing U.S. export volumes of individual commodities by respective per-acre yields. For example, more than 42 million metric tons of food grains are forecast to be exported during fiscal 1988, an acreage equivalent of 40 million. Oil crops are expected to account for a 30-million-acre equivalent, feed grains for 21 million acres, and cotton for 5 million acres.

Table 8.--Indices of crop production per acre of cropland used for crops, by region

Region	1969	1974	1978	1982	1984	1985	1986	1987 1/
	1977 = 100							
Northeast	109	106	109	114	116	120	112	110
Lake States	86	78	102	114	110	114	114	119
Corn Belt	93	77	108	117	105	124	124	122
Northern Plains	84	77	110	120	118	129	131	127
Appalachian	114	108	109	120	116	111	95	100
Southeast	113	125	114	133	129	135	121	139
Delta States	101	100	100	118	118	114	106	122
Southern Plains	80	77	88	91	100	105	92	116
Mountain	92	98	109	116	107	104	112	123
Pacific	87	97	95	115	121	124	122	139
United States 2/	91	[redacted]	105	116	112	120	116	122

1/ Preliminary. 2/ Includes the 48 conterminous States.

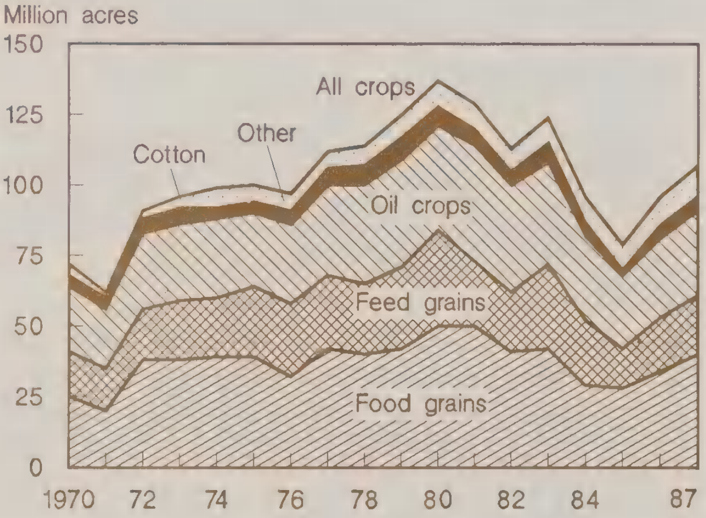
Table 9.--Acreage equivalents of U.S. crops exported, 1970-87 1/

Cropland	1970	1975	1979	1983	1985	1986	1987 2/
				Million acres			
All crops harvested 3/	293	336	348	306	342	325	301
Used for exports:							
Food grains	25	39	42	42	28	34	40
Feed grains	16	25	29	30	14	19	21
Oil crops	23	26	38	36	26	28	30
Cotton	4	4	8	7	2	5	5
Other crops	4	6	8	9	9	10	11
Total	72	100	125	124	79	96	107
				Percent exported 3/			
All crops harvested 4/	25	30	36	41	23	30	36
				Percent of total acreage equivalents			
Used for exports:							
Food grains	35	39	34	34	35	35	38
Feed grains	22	25	23	24	18	19	20
Oil crops	32	26	31	29	33	29	28
Cotton	6	4	6	6	2	6	4
Other crops	5	6	6	7	12	11	10
Total	100	100	100	100	100	100	100

1/ For 12 months beginning July 1 for 1970 and October 1 thereafter. 2/ Preliminary. 3/ Acreage equivalents of exports as a percentage of all crops harvested. 4/ Includes all cropland harvested plus acres double cropped during the calendar year.

Figure 3

Acreage Equivalents of U.S. Crops Exported



Exports in fiscal 1988 are expected to account for 36 percent of all acres harvested in 1987 (table 9). This is up from last year's 30 percent.

Food grains represent 38 percent of total acreage equivalents in fiscal 1988, feed grains 20 percent, and oil crops 28 percent. While the mix of exports has varied annually, the acreage equivalent of exports tended to increase during the 70's, decrease from 1980 to 1985, and to increase again since 1985 (fig. 3). The acreage equivalents of "other crops" exported have generally increased since the early 70's, although they have comprised a smaller percentage of exports since 1985.

EXCESS CAPACITY IN AMERICAN AGRICULTURE - 1987

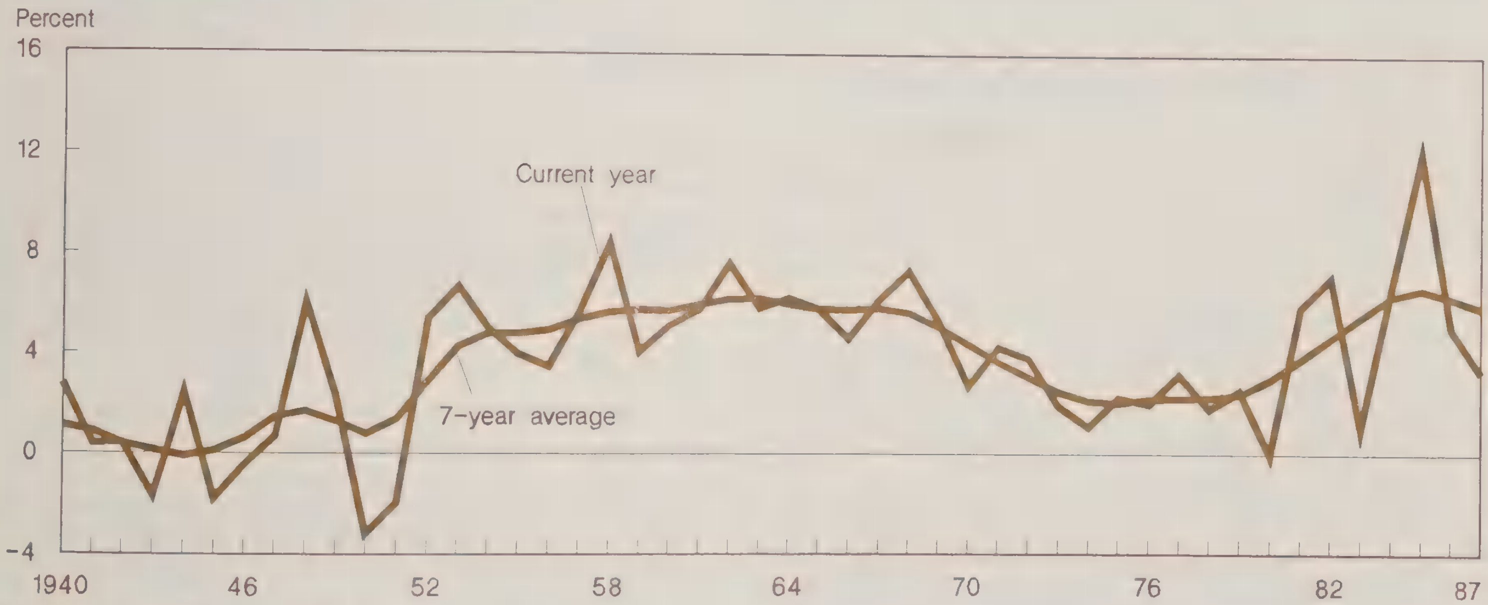
Excess capacity decreased dramatically in 1987 from the high reached in 1985 (figure 4). Final data for 1988 are not available yet, but continued high exports and the summer drought will likely extend this decline. The 1985 peak exceeded the previous peak of the 1960's, and resulted from greater agricultural output in the early 1980's and significant declines in agricultural exports after 1981. The intervening decline in excess capacity in the 1970's was caused by poor grain harvests abroad, favorable exchange rates, and the opening of new markets in the developing world. As the domestic market became increasingly responsive to these outside factors, the year-to-year variation in excess capacity increased. Excess capacity decreased between 1985 and 1987 because exports and domestic use of the major crops increased since 1985 and because the planted and diverted acreage of the major crops has decreased.

Excess capacity is the difference between "commercial demand" and "potential supply" at current market prices.[2] Commercial demand is the value of production that can be cleared by the commercial market (domestic and foreign demand); it excludes various food gift programs. Potential supply is actual production plus imports plus potential output from acreage that has been idled by Government acreage reduction programs (excluding acreage idled for soil conservation purposes, such as the Conservation Reserve Program). Consequently, excess capacity deals only with commodities that are storable and covered by price-support or diversion programs: wheat, corn, oats, barley, sorghum, cotton, soybeans, rye, rice, tobacco, peanuts, and dairy products. Seasonal or short term surpluses of such perishable agricultural products as fruits and vegetables are usually regarded as insignificant in terms of long-run excess capacity.

This concept of excess capacity needs to be distinguished from the concept of the physical capacity of American agriculture. The maximum physical capacity of the Nation's resources is much larger than the excess capacity measured here. Excess capacity estimates the additional resources that are committed to agricultural production purely as a result of Government price support programs at current support levels, rather than as a result of underlying market forces. A judgment of the optimum level of excess capacity needs to account for the benefits of income maintenance to farmers and rural communities, the prevention of the risk of food shortages caused by droughts or other hazards through the marketing of Government-owned surplus stocks, and a more orderly planning process for farmers who will be protected from unforeseen variations in prices.

Figure 4

Excess Capacity in 12 Commodities



Percentage of total U.S. production of the 12 commodities.

[2]Dvoskin, Dan. Excess Capacity in U.S. Agriculture: An Economic Approach to Measurement. AER 580. USDA, ERS. Feb. 1988.

TRADE LIBERALIZATION MAY AFFECT RESOURCES AND RESOURCE POLICIES

Most nations have enacted agricultural policies that affect demand for U.S. exports and, hence, resource use. For example, the Soviet decision in the early 1970's to import grains for livestock expansion led to a 9.4-million-ton increase in purchases of U.S. wheat in crop year 1972/73. European Community (EC) import tariffs on grains have largely prevented U.S. grains from competing in that market. In Japan, state trading in food grains and livestock severely restricts imports of those commodities. In the United States, the 1985 Food Security Act (FSA) includes provisions such as the Export Enhancement Program and the Targeted Export Assistance Program to promote commodity exports.

As export demands change, so can the use of agricultural resources. During the 1970's U.S. exports of wheat, corn, and soybeans rose 104 percent, 356 percent, and 67 percent, respectively. Between 1971 and 1981, harvested acreage of these crops expanded 44 percent. Land use intensified as per acre application of fertilizer, agricultural chemicals, and water for irrigation increased. At the same time, concerns were voiced that we were achieving greater production at the expense of excessive soil erosion, overuse of ground and surface water, and irreversible loss of wetlands and prairies. Although commodity exports declined from peaks in 1980 and 1981, environmental concerns have remained as evidenced by conservation provisions of the 1985 FSA and by the 1987 Water Quality Act.

World Agricultural Policy Reforms Are Underway

Policies of trading nations to promote exports and protect domestic markets and producer incomes have restricted world trade, dramatically increased costs of farm support programs, and created surpluses of major commodities. At the July 1987 meetings of the General Agreement on Tariffs and Trade (GATT), the United States proposed that all countries liberalize trade by eliminating all forms of support and protection for agricultural production over a 10-year period. The major focus would be on eliminating import barriers, government support including export subsidies, and the use of health and sanitary regulations that restrict trade. In response, the EC called for 1) short-term measures to stabilize commodity markets and reduce farm support costs and 2) at a later date long-term measures to reduce trade distortions. While it is expected that reform will occur, the timetable and nature of reform are highly uncertain. A mid-term review of the GATT will be held in Montreal on December 5, 1988.

A key question is what resource policies may be modified or eliminated in GATT negotiations. Decisions may turn on the extent to which a policy is directly "trade-distorting." Resource policies, because they either restrict or promote use of resource inputs, can change relative crop production costs between commodities and countries and therefore potentially affect trade.

Because the United States places a high social value on the environment, it has enacted policies to restrict private use of natural resources in order to retard degradation of soil fertility and clean water supplies, or to protect wildlife habitat. While policies enacted solely to enhance the environment may affect trade, they may not be considered "trade-distorting" from the perspective of the GATT. On the other hand, resource policies that have an explicit commodity supply control purpose may be considered in part "trade-distorting" and subject to negotiation.

U.S. resource policies that could receive scrutiny by GATT negotiators include: pricing of irrigation water on Bureau of Reclamation (Bureau) projects, grazing fees on public ranges, and soil conservation assistance. The Bureau's policy is discussed in detail by Moore and McGuckin later in this report.

Some 2 percent of the Nation's livestock producers rented Federal grazing lands at below market rates in 1982. In that year, the area so grazed accounted for 10 percent of the Nation's total rangeland forage.

The CRP, discussed in detail later in this report, is primarily a resource conservation program. For the most part, only highly erodible cropland is eligible for enrollment. Due to its environmental focus, the CRP would not appear to be subject to GATT negotiation. At the same time, curbing surplus commodity production is considered among the CRP's secondary benefits, according to USDA rules and regulations for the CRP. Supply reduction occurs because CRP participation requires that a farm's cropland base acreage in program crops be reduced.

Although it is far too early to know what policy reform will involve, changes in demand for U.S. exports will affect the use of our land and water resources. The size and regional distribution of these resource impacts are also unknown but it is reasonable to assume that the degree of adjustment will depend upon regional comparative advantage, crop mix, and current participation in Federal programs.

SOIL CONSERVATION

Annual damages to the Nation's cropland and water resources from soil erosion on agricultural lands were estimated to be between $5 billion and $13 billion in the early 1980's (table 10). Major policy revisions and land treatment efforts directed toward reducing these damages are now being implemented and are beginning to have an affect. Partial implementation of the conservation provisions in the 1985 Food Security Act; continuation of traditional Federal, State, and local programs; and private initiatives have contributed to the recent conservation achievements.

CRP Dominates Efforts

One of the major soil conservation efforts in 1988 continues to be the Conservation Reserve Program (CRP), which was initiated in 1986 to convert highly erodible land to conserving uses. The CRP now surpasses the traditional conservation programs in terms of treated acres, reduced soil

Table 10. Soil erosion levels, damages, and major treatment programs.

Soil Erosion Levels . . .

- U.S. agricultural land (cropland, pasture, and range) in the early 1980's averaged over 4 billion tons of eroded soil annually, with 60 percent from water based erosion and 40 percent from wind erosion.
- Highly erodible cropland, just over one-tenth of total agricultural land, was contributing over two-fifths of total agricultural erosion.

Causing Damage On and Offsite . . .

- $1 billion damage annually to soil productivity (lower future crop yields and higher fertilizer applications).
- $2 billion to $8 billion damage annually off-site to water related activities such as recreation, water treatment, water storage, irrigation, navigation, and from flooding.
- $2 to $4 billion damage annually from wind erosion and dust.

Are Being Treated by Older Conservation Programs . . .

- Agricultural Conservation Program (ACP): provides financial assistance to farmers for implementing approved soil and water conservation practices. Cost share payments to a given farmer cannot exceed $3,500 per year. Program initiated in 1936.
- Conservation Technical Assistance (CTA): provides technical assistance by the Soil Conservation Service and Conservation Districts to farmers for implementing soil and water conserving and water quality practices. Program initiated in 1936 and is free to farmers generally on a first come-first serve basis, except some targeting of services to the most critical areas is now occurring.
- Great Plains Conservation Program (GPCP): provides technical and financial assistance in Great Plains states to farmers and ranchers who implement total conservation treatment of their entire operation. Financial cost-share assistance limited to $35,000 per farmer contract. Program initiated in 1957.
- Small Watershed Program: provides federal technical and financial help to local organizations for flood prevention, watershed protection, and water management. Part of this effort involves establishment of measures to reduce erosion, sedimentation, and runoff. Program initiated in 1954.

And New Food Security Act (FSA) Programs.

- Conservation Reserve Program (CRP): provides annual rental payments to land owners and operators who voluntarily retire highly erodible and other environmentally critical lands from crop production for 10 years. Also provides technical assistance and cost share payments up to 50 percent of the cost of establishing a soil conserving cover on the retired land. Rental payments to any person may not exceed $50,000 per year. County enrollment limited to no more than 25 percent of cropland unless a special waiver is given by USDA. Program initiated in 1986.
- Sodbuster: requires that farmers who convert highly erodible land to crop production must do so under an approved conservation plan to maintain soil erosion at or below the soil loss tolerance level, or forfeit eligibility for USDA program benefits. Program initiated in 1986.
- Swampbuster: requires that farmers who convert wetlands to crop production lose eligibility for USDA program benefits unless USDA determines that conversion would have only a minimal effect on wetland hydrology and biology. Program initiated in 1986.
- Conservation Compliance: requires that farmers with highly-erodible cropland have in place an approved conservation plan on such land by Jan. 1, 1990 and complete implementation of the plan by 1995, or lose eligibility for USDA program benefits.

Source: (2,4,5,8)

Table 11.--Sign up for the Conservation Reserve Program

Item	Number of contracts	Number of acres	Average rental rate	Average erosion reduction
	1,000	Million	$/acre/yr.	Tons/acre/yr.
Sign up period				
#1 March 1986 1/	9.4	0.75	42.06	26
#2 May 1986 1/	21.5	2.77	44.05	27
#3 August 1986 2/	34.0	4.70	46.96	25
#4 February 1987 3/	88.0	9.48	51.19	19
#5 July 1987 3/	43.7	4.44	48.03	17
#6 February 1988 4/	42.7	3.38	47.90	18
Total	239.3	25.53	48.40	21
Cumulative enrollment by crop year				
1986	21.0	2.04	43.11	28
1987	145.9	15.71	49.15	23
1988 tentative	228.6	24.25	48.52	21
1989 tentative	239.3	25.53	48.40	21

1/ Eligible acres included cropland in land capability classes II through V eroding at least three times greater than the tolerance rate (see definitions), or any cropland in land capability classes VI through VIII. 2/ Eligible acres expanded to include cropland in land capability classes II through V eroding at least two times the tolerance rate and having gully erosion. 3/ Eligible acres expanded to include cropland eroding above the tolerance rate with an erodibility index of eight or greater. 4/ Eligible acres expanded to include cropland in land capability classes II through V eroding at least two times the tolerance rate if planted in trees. Eligibility also extended to cropland areas 66 to 99 feet wide adjacent to permanent water bodies for placement in filter strips.

Table 12.--Regional distribution of current Conservation Reserve Program enrollment and eligibility

Region	CRP through February 1988			CRP eligibility		
	Enrolled acres	Share of U.S. enrolled acres	Percent of region's cropland	County constrained eligible acres /2	Share of U.S. total	Percent of region's cropland
	Million	-- Percent --		Million	--- Percent ---	
Northeast	0.13	0.5	0.8	3.0	4.3	17.4
Lake States	2.07	8.1	4.7	5.7	8.2	13.0
Corn Belt	3.56	13.9	3.9	16.4	23.5	17.7
Northern Plains	6.04	23.7	6.5	13.3	19.2	14.2
Appalachian	0.86	3.4	3.8	4.7	6.7	20.6
Southeast	1.25	4.9	6.8	2.7	3.9	14.8
Delta States	0.78	3.0	3.5	2.1	3.0	9.6
Southern Plains	4.10	16.1	9.1	8.7	12.5	19.4
Mountain	5.22	20.4	12.1	10.0	14.3	23.1
Pacific	1.51	5.9	6.7	3.1	4.5	13.7
United States 1/	25.53	100.0	6.1	69.7	100.0	16.6

1/ Contiguous States. 2/ Enrollment constrained to no more than 25 percent of the cropland in each county.

erosion, and Federal expenditures. Over 24 million acres of land previously used for crops were scheduled to be in permanent vegetative cover in 1988 and estimated to reduce average annual erosion by 500 million tons. The 1988 Federal expenditure for the CRP, which includes annual rental payments, cost sharing, and technical assistance, is $1.2 billion, over one-half of total USDA expenditures for land and water conservation.

CRP enrollment increases to 25.5 million acres. Counting an additional 1.3 million acres scheduled for retirement in 1989, total enrollment in the CRP through the sixth sign up was 25.5 million acres representing 239,000 contracts (table 11). Seven sign up periods have occurred since the program began in 1986, with the last taking place July 18 - August 31, 1988. During all but the first sign up, farmers have been permitted to enroll their acreage for the current year or for the following year. Only preliminary information for the seventh sign up is currently available. It shows that USDA received bids for a total of 3.4 million acres including 228,000 acres which were offered for tree planting. Actual contracted acreage from the seventh sign up will be announced in December. Based on past sign ups, the contracted acreage will be less than the bid acreage. As in previous Fall sign ups, nearly all of the acres bid were designated for retirement in 1989.

Total CRP enrollment is limited to a maximum of 25 percent of the cropland in a county unless a special waiver is granted. Thus far, 55 of 2,326 counties enrolling land in the CRP have reached the 25-percent level with 47 of these granted waivers to exceed the 25-percent limit.

Figure 5

Conservation Reserve Program Enrollment through the Sixth Signup

Table 13.--Conservation Reserve Program acreage treated by conservation practices, February 1988

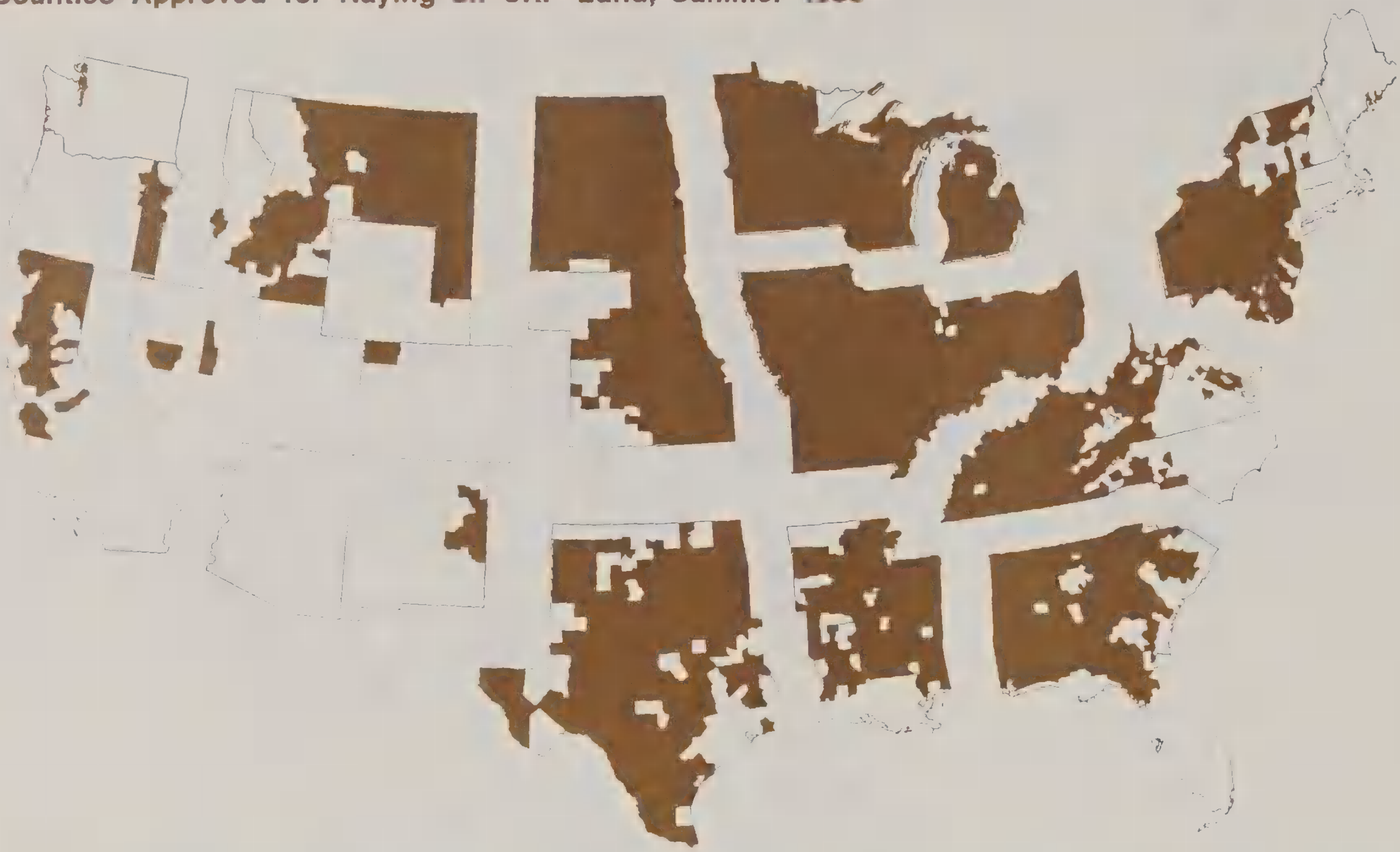
Practice	1986	1987	1988	1989	Total enrollment	Share of acres enrolled
	Acres enrolled by crop year				Total enrollment	
	Thousand acres					percent
Grass cover	1,700	12,416	7,672	1,077	22,865	89.2
Tree planting	213	759	474	135	1,582	6.2
Wildlife habitat	126	488	374	61	1,049	4.1
Field windbreaks	1	3	1	-	5	-
Diversions	10	26	33	-	69	0.3
Erosion, sediment, & water control structures	9	22	8	-	39	0.2
Grass and sod waterways	2	5	2	-	9	-
Shallow water areas	-	1	2	-	2	-
Filter strips 1/	-	-	13	3	16	0.1
Total 2/	2,043	13,670	8,536	1,276	25,525	100.0

1/ Filter strips were approved [illegible] CRP conservation practice beginning with the sixth sign up held during February 1988. 2/ Acres where more than one practice was applied are counted only once in the total.

Erosion reduction averages 21 tons per acre. The long-run average annual reduction in erosion for all land enrolled in the first six sign ups is estimated at 21 tons per acre. The average has tended to decline with each sign up. The average reduction rate for land enrolled in the sixth sign up is estimated at 18 tons per acre, down from over 25 tons estimated for land enrolled in the first three sign ups (table 11). One reason for the decrease is that changes in program rules have expanded eligibility to include land which, while not actually experiencing excessive erosion, has the potential to erode heavily or directly affect water quality. Another reason is that regional shifts in enrollment are bringing less erosive land into the program.

Rental payments average $48 per acre. USDA rental payments to farmers averaged $48 per acre for all land enrolled in the program through the sixth sign up (table 11). The rental rates were slightly higher in the fourth, fifth, and sixth

Figure [illegible]
Counties Approved for Haying on CRP Land, Summer 1988



sign ups than in the earlier ones. This is partially explained by the shift in enrollments to areas with higher land values and cash rents. Also, farmers have better knowledge of the USDA maximum acceptable rental rate for their area, and may tend to submit bids near this expected maximum. Not reflected in the USDA rental rates is the increasing number of situations in which USDA rental payments or cover establishment costs are being supplemented by State contributions.

Enrollment highest in the West. Heaviest acreage enrollment has been in the Northern and Southern Plains and the Mountain region (figure 5). Together these regions account for 60 percent of enrollment but comprise only 46 percent of eligible land (table 12). Conversely, the Corn Belt, which contains approximately 24 percent of the eligible land, accounts for only 14 percent of enrollment.

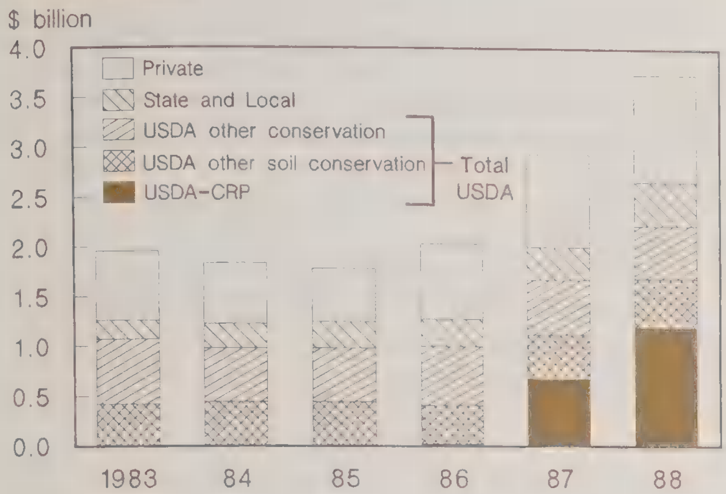
Grass dominates conservation treatments. Most of the land enrolled in the Conservation Reserve has been or will be placed in grass (89 percent) (table 13). The legislation establishing the CRP calls for 12.5 percent of the 40- to 45-million-acre enrollment goal to be devoted to trees. Currently only 6 percent of the enrollment is planted to trees. Wildlife habitat, diversions, various erosion control structures, and filter strips are also acceptable conservation alternatives.

Program changes encourage enrollment, planting trees, and protecting water quality. To modify the regional imbalance of enrolled acres relative to eligible acres, increase tree planting, and improve water quality, USDA made several program changes beginning with the sixth sign up. To encourage greater participation in the Corn Belt and around the Chesapeake Bay, maximum acceptable rental rates (MARRs) were increased by up to $25 per acre in these areas. In all counties, ASC committees were made responsible for ensuring that CRP rental payments do not exceed local market cash rents for comparable cropland. For the sixth sign up, 108 counties decreased the maximum acceptable rental rate from what was established for the previous sign up. The decreases ranged from a few cents to $30 per acre.

To encourage tree planting, erosion eligibility requirements on acres to be planted to trees were reduced from three times the normal soil loss tolerance level (3T) to two times the tolerance (2T). This change increased eligible acres by 1.5 million in regions where tree planting is most popular. Additionally, the field predominance requirement for tree planting was reduced. Beginning with the sixth sign up, a field that contains only one-third highly erodible soil may be enrolled if placed in trees. Together, these changes resulted in over 12 percent of sixth sign up acreage being planted to trees. Tree planting was especially strong in the South where it accounted for 94 percent of total enrollment in Georgia and 91 percent in Florida.

Figure 7

U.S. Land and Water Conservation Expenditures



Sources: (6,7,11,12)

To achieve additional water quality improvements from the CRP, filter strips were added as an approved conservation practice. Filter strips, 66 to 99 feet in width, may be placed on cropland adjacent to streams, lakes, estuaries, and other permanent bodies of water. Land used for filter strips does not have to meet any of the erodibility criteria. Considering only cropland bordering rivers, it is estimated that the addition of filter strips may have expanded CRP eligibility by approximately 2.9 million acres. Thus far only about 16,000 acres have been enrolled as filter strips.

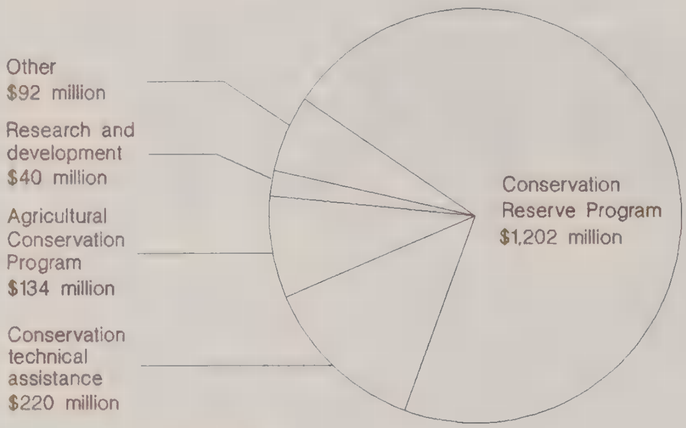
Special drought provision. To assist farmers suffering the effects of this year's drought, as of August 1 the Secretary of Agriculture had allowed farmers in nearly 2,200 counties to harvest grass on CRP land (figure 6). Grazing of CRP land, which was judged to be inconsistent with the program's soil conservation goals, was not approved. Normally, haying, grazing, or other commercial use of forage on CRP acreage are not permitted. In return for the right to hay during a 30-

Table 14.--USDA conservation expenditures from appropriations, fiscal 1986-89 1/

Activities and programs 2/	All conservation expenditures				Soil conservation 3/			
	1986 actual	1987 actual	1988 estimated	1989 budgeted	1986 actual	1987 actual	1988 estimated	1989 budgeted
	$ Million							
A. On-farm technical assistance and extension	323.3	373.9	410.6	404.9	167.0	209.9	245.0	247.6
Conservation technical assistance (SCS) 4/	286.2	328.5	366.0	376.0	148.8	180.7	219.6	225.6
Extension information and education (ES)	16.3	15.7	16.6	13.9	7.3	7.1	8.3	7.0
Cooperative forestry management (FS)	10.0	7.7	11.0	0.0	0.1	0.1	0.1	0.0
Technical/assistance--CRP (SCS/ASCS) 5/	10.8	22.0	17.0	15.0	10.8	22.0	17.0	15.0
B. On-farm installation cost-sharing	192.3	463.3	634.6	493.3	136.8	399.6	571.0	489.6
Agricultural Conservation Program (ASCS)	138.9	176.9	176.9	0.0	105.5	134.5	134.5	0
Forest Incentives Program (ASCS)	11.2	11.9	11.9	0.0	11.2	11.9	11.9	0
Water Bank Program (ASCS)	9.3	8.4	8.4	0.0	0	0	0	0
Great Plains Conservation Program (SCS)	20.5	20.5	20.5	6.0	7.7	7.7	7.7	2.3
Cover establishment--CRP (ASCS/CCC) 5/	12.4	245.5	416.9	487.3	12.4	245.5	416.9	487.3
C. Project conservation programs	292.3	210.8	199.6	131.2	33.3	24.7	23.7	16.7
Watershed and flood prevention (SCS)	265.2	185.8	174.5	106.2	26.5	18.6	17.5	10.6
Resource conservation & development (SCS)	27.1	25.0	25.1	25.0	6.8	6.1	6.2	6.1
D. Subtotal for implementation (A+B+C)	807.9	1,056.0	1,244.8	1,029.4	337.1	634.2	839.7	753.9
E. Conservation research and development	120.3	135.3	130.1	130.7	37.8	43.1	39.5	38.4
Research on soil and water conservation (ARS)	62.4	59.3	60.8	66.6	15.6	14.8	15.2	16.6
Cooperative State research (CSRS)	29.8	39.7	32.0	26.9	14.9	19.8	16.0	13.5
Forest environment research (FS)	20.2	27.7	29.3	29.1	2.6	3.3	3.5	3.5
Plant materials centers (SCS)	3.9	4.6	4.9	5.1	2.3	2.8	2.9	3.0
Resource economics research (ERS)	4.0	4.0	3.1	3.0	2.4	2.4	1.9	1.8
F. Data collection and analysis (SCS) 6/	72.2	74.8	85.1	83.9	32.6	34.8	40.8	41.2
G. Rental payments--CRP (ASCS/CCC) 7/	0	410.0	767.6	1,202.3	0	410.1	767.6	1,202.3
H. Total distributed expenditures (D+E+F+G) 8/	1,000.4	1,676.1	2,227.6	2,446.3	407.5	1,122.1	1,687.6	2,035.8
--Share for erosion control (percent)	40.7	66.9	75.8	83.2				

1/ Current dollar estimates from Budget of the U.S. Government for Fiscal Year 1989 (Appendix) (12), supplemented with unofficial data from several sources (6,7,11). 2/ Responsible USDA agencies in parentheses: CCC--Commodity Credit Corporation; SCS--Soil Conservation Service; ES--Extension Service; FS--Forest Service; ASCS--Agricultural Stabilization and Conservation Service; ARS--Agricultural Research Service; CSRS--Cooperative State Research Service; and ERS--Economic Research Service. 3/ Soil conservation expenditures are not in the official budget but are estimated from published erosion control percentages given for individual USDA programs (6) and from unpublished estimates. Those percentages by programs are assumed to remain substantially unchanged between 1986 and 1989. 4/ Includes the SCS inventory and monitoring, resource appraisal, and program development activities. 5/ Technical assistance and cover establishment components of the CRP are assumed to be all soil conservation, as highly erodible lands are the program's principal focus. 6/ Includes river basin surveys and investigations, soil surveys, and snow survey water forecasting. 7/ Included as soil conservation, since the CRP's principal purpose is conservation. 8/ Includes those programmed and nonrepayable expenditures that can be allocated to soil and water conservation, wildlife, and other resource concerns. Not included are FmHA loan programs and ASCS emergency conservation programs.

Figure [illegible]
USDA Soil Conservation Programs and Expenditures, 1988



Total expenditures: $1,688 million.

day period, farmers using this special provision were required to mow no closer than 3 inches, preserve 10 percent of their grass cover acreage, and leave buffer strips. Farmers were also told that they would be required to relinquish 25 percent of their 1988 CRP rental payment for hayed land. If the hay was donated to other farmers, there was to be no reduction in rental payment. With passage of the Disaster Assistance Act of 1988 (PL-100-387), farmers who experienced a reduction in their 1988 CRP rental payment as a result of haying will be repaid.

CRP Pushes Up Conservation Expenditures

Total public and private expenditures related to land and water conservation programs could expand to about $3.8 billion in 1988, up over $.8 billion from 1987 and $1.7 billion above the 1986 level (figure 7). The $1.2 billion for the CRP, up over $.5 billion from 1987, is the dominant cause for the increase. The CRP also has supply control benefits and reduces the USDA expenditure for commodity price support programs. Private conservation expenditures could increase to $1.2 billion as farmers pay their share to establish permanent vegetative covers on CRP acreage and adopt conservation practices on other land. A one-third increase in State and local government appropriations is estimated to cover local programs, and in some States, to supplement the Federal CRP rental payment and the establishment cost for the vegetative cover (11).

USDA land and water conservation and erosion control expenditures in 1988 may reach an estimated $2.2 billion, up $.6 billion (33 percent) from 1987 and up $1.2 billion (120 percent) from 1986 (table 14). The $2.4 billion proposed in the budget for fiscal 1989 is higher than 1988 estimate, but it includes recommendations for consolidation and reduction in some programs, and the actual termination of several on-farm cost sharing programs. The drought prevalent over large portions of the Nation's cropland may result in higher conservation expenditures than have been estimated for 1988 and 1989. For example, expenditures for vegetative cover establishment are expected to increase due to the need for replanting.

The $1.2 billion for the CRP represents over 70 percent of USDA expenditures for soil conservation programs (figure 8). Expenditures for other soil conservation programs total less than $ .5 billion.

Other Conservation Programs Moving Ahead

Three other conservation provisions of the 1985 FSA are being implemented: sodbuster, swampbuster, and conservation compliance (table 10). In addition older conservation programs are being directed to more critical problems.

Table 15.--Cropland affected by conservation compliance

Region	Cropland requiring compliance by 1990				
	Total before CRP 1/	Maximum enrolled in CRP through February 1988 2/	Balance requiring compliance by 1990 or enrollment in CRP: Minimum area 3/	Share of U.S. total	Share of region's cropland
	Million acres			Percent	
Northeast	3.7	0.1	3.6	6.2	21
Lake States	3.9	2.1	1.8	3.2	4
Corn Belt	19.1	3.6	15.5	26.8	17
Northern Plains	13.8	6.0	7.8	13.5	[illegible]
Appalachian	5.9	0.9	5.0	8.6	22
Southeast	2.7	1.2	1.5	2.6	8
Delta States	2.3	0.8	1.5	2.7	7
Southern Plains	13.8	4.1	9.7	16.8	22
Mountain	14.7	5.2	9.5	16.4	22
Pacific	3.5	1.5	2.0	3.5	9
United States	83.4	25.5	57.9	100.0	14

1/ Includes all lands with an erodibility index (EI) equal to or greater than 8, excluding 35 million acres of such cropland eroding at T level or less under current use and management (and thus considered as already being under compliance). 2/ Maximum acreage, based on assumption that all CRP enrollment through February 1988 had EI equal to or greater than 8. 3/ Could be slightly greater to the extent that some CRP acreage included lands with EI less than 8.

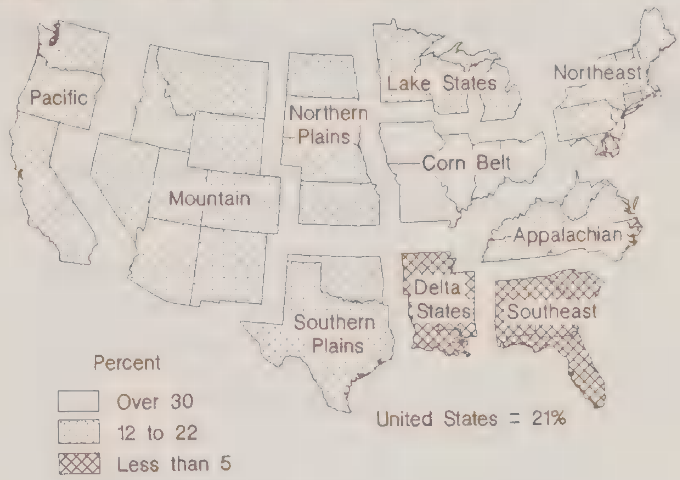
Sodbuster. Since enforcement of this provision began in December 1986, eligibility for USDA program benefits have been forfeited by 105 farmers for converting highly erodible land to crop production without implementing an approved conservation plan. The total value of USDA program benefits forgone by these farmers amounts to nearly $1.9 million with over half lost by farmers in the southwestern States.

Swampbuster. There are only five known instances in which farmers had their USDA program benefits revoked because they converted wetlands to crop production.

Conservation compliance. According to the 1982 National Resources Inventory an estimated 118 million acres of cropland are considered highly erodible under the conservation compliance provision. Approximately 35 million of these acres already meet compliance with existing practices, and up to 25 million have been enrolled in the CRP. This leaves at least 58 million remaining acres that still require treatment for the compliance provision (table 15). About 15.5 million (25 percent) of these acres are located in the Corn Belt, 10 million each in the Southern Plains and Mountain regions, and 8 million in the Northern Plains. To meet compliance, farm owners or operators must have an approved conservation plan for their highly erodible land by January 1, 1990, and have the plan implemented before 1995 or forego USDA benefits.

Conservation compliance will be determined at the field level. Since many fields contain some land not strictly classified as highly erodible, the number of acres potentially subject to compliance will be greater than 118 million. Currently, the Soil Conservation Service (SCS) estimates that nearly 144 million acres are potentially affected by conservation compliance.(10) As of July 1, USDA had made determinations of the highly erodible status of approximately 109 million acres of cropland, and informed the owners and operators. Also, conservation plans had been completed by USDA for approximately 55 million acres representing 38 percent of the estimated potential acreage. USDA's goal is to complete 65 percent of required conservation plans by the end of 1988. Conservation plans have been implemented on 17 million acres of highly erodible land. USDA has announced that strict adherence to the soil loss tolerance rate will not be a criterion for conservation plan approval. Approved conservation plans will be based on SCS field office technical guides. These guides contain acceptable systems judged to be economically and technically feasible for local areas.

Figure 9
Conservation Tillage's Share of Each Region's Total Acres Planted, 1987



Traditional Conservation Programs. Increased portions of Conservation Technical Assistance (CTA) and Agricultural Conservation Program (ACP) resources are being devoted to cropland with high erosion. In 1987, about half of the total acres treated by these programs were eroding at twice the tolerance level or higher, compared with 36 percent in 1983. The National Program for Soil and Water Conservation developed in 1982 called for even greater targeting

Table 16.--Regional distribution and importance of conservation tillage (CT) in 1986 and 1987

Region	1986	1987 preliminary		
	Total acres with CT	Total acres with CT	Share of U.S. acres with CT	Share with CT of region's acres planted
	--- Million Acres ---		--------- Percent ---------	
Corn Belt	2[illegible].8	20.6	44.8	32
Northern Plains	15.7	10.6	23.1	22
Lake States	7.6	4.6	10.0	20
Mountain	7.6	2.9	6.2	18
Southern Plains	3.7	2.3	5.1	12
Appalachian	1.9	1.7	3.7	17
Northeast	2.0	1.3	2.9	19
Delta States	0.6	0.4	0.8	3
Pacific	1.9	1.4	3.0	14
Southeast	0.9	0.2	0.4	2
United States	65.7	46.0	100.0	21

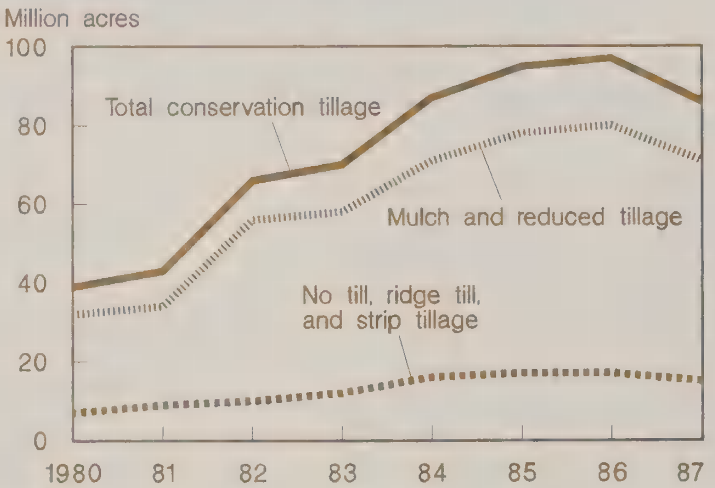
of traditional CTA and ACP resources to priority erosion areas. But USDA appropriations only partially permitted the necessary redistribution of ACP and CTA funds among States and conservation districts. Instead, the new programs, the CRP and compliance, are achieving the greater targeting originally envisioned.

Most Used Practices Are Rotations, Conservation Tillage, and Grass Cover

The most used soil conservation practices in terms of acres benefited are conservation crops in rotation, conservation tillage, and with the CRP expansion, cropland conversion to grass or trees. Of total ACP cost sharing, about one-third goes for grass or tree cover, one-seventh for terraces and diversions, and another seventh for irrigation improvements to reduce erosion (1). Some 6-7 percent goes to further conservation tillage, and the balance goes into various other practices. No data are available on CTA and other program efforts by practice.

Farmers implementing conservation tillage have benefited from SCS and Extension Service technical assistance, and in some cases from ACP and other Federal and State cost sharing, but have borne most of the transition costs themselves. Conservation tillage methods involve fewer tillage operations and more crop residue left on the surface than with conventional tillage. This usually reduces tillage cost, helps retain moisture, and conserves soil by reducing erosion rates by one-half or more compared to conventional methods.

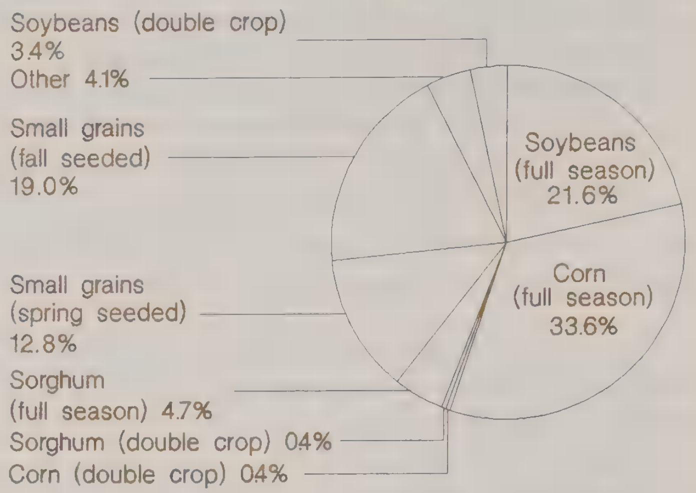
Figure 10
National Use of Conservation Tillage



Sources: (3,9)

[1] The coefficient of variation for the national estimate is 4.5 percent. The 1987 conservation tillage estimate can be set, with 95 percent confidence, to occur between 41.7 and 50.0 million acres.

Figure 11
Share by Major Crop of Total Acres Planted with Conservation Tillage, 1987



Source: (3)

Total acreage in conservation tillage in 1987 probably declined from 1986, apparently because many of the acres idled under Federal programs were previously under the practice. Available national estimates of conservation tillage in 1987 range from 46 million to 86 million acres. The lower estimate is based on a USDA survey of farm operators, while the higher estimate is from the Conservation Technology Information Center (3).

Conservation tillage based on USDA's Farm Costs and Returns Survey was estimated to be used on 46 million (21 percent) of the planted acres in 1987 (table 16).[1] Regions with the largest area planted to crops, the Corn Belt, Northern Plains, and Lake States, also reported the largest acreage with conservation tillage, and among them accounted for about 78 percent of the Nation's conservation tilled acres (table 16). The Corn Belt had the highest rate of conservation tillage use (32 percent) on planted acres in 1987 (figure 9). The Northern Plains and Lake States also used conservation tillage on 20 percent or more of their planted area. The regions with lowest relative rates (5 percent or less) include the Delta States and Southeast.

Data gathered by the Conservation Technology Information Center (CTIC) from district conservationists of the Soil Conservation Service provide an historical perspective on the adoption and use of conservation tillage (figure 10). While the CTIC estimates of conservation tillage use are higher than those from the USDA survey, their information indicates similar trends. Although no-till, ridge till, and strip tillage generally provide the most erosion control, they accounted for only about 18 percent of all types of conservation tillage applied in 1987. According to the CTIC, the use

Table 17.--Average annual cropland erosion prevented by USDA programs

Treatment category and program	1985 estimate	1986 estimate	1987 estimate	1988 projection	1990 projection
	Million tons				
Erosion prevented on lands newly treated under:					
CRP 1/	-	57	300	145	
ACP 2/	41	30	25	25	
CTA only 3/	62	66	71	71	
ARP 4/	61	92	119	108	
Total	164	245	515	349	
Erosion prevented on lands previously treated under:					
CRP 1/	-	-	57	357	685-776
ACP	(No estimates available)				
CTA only	(No estimates available)				
Total erosion prevented:					
All treated lands with available data 5/	164	245	572	706	
CRP only	-	57	357	502	685-776

1/ Conservation Reserve Program. 2/ Agricultural Conservation Program. 3/ Conservation Technical Assistance apart from that provided under ACP. 4/ Annual Acreage Reduction Programs. Assumes an average soil erosion reduction of 2 tons/acre/year because of idling the land and less cultivation. 5/ Includes CRP and the erosion prevented on land newly treated under other programs.

of ridge till increased in 1987, while the use of other conservation tillage techniques declined.

Corn and small grains each accounted for about one-third of the acreage planted using conservation tillage in 1987 (figure 11). Soybeans (both full season and double crop) used about one-fourth of the conservation tilled acreage, and sorghum was the remaining principal crop with substantial conservation tillage.

According to CTIC estimates, conservation tillage in 1987 was frequently used with double cropping. About 57 percent of the double cropped soybeans, 52 percent of the double cropped corn, and 46 percent of the double cropped sorghum used the practice. Among the full season or first crops, corn had the highest relative use at 42 percent, followed by soybeans, small grains, and sorghum at 30 percent or higher.

Erosion Reductions Are Accumulating

Sufficient information on land use and net change in applied conservation treatments can only be periodically obtained to fully assess national conservation achievements. Achievements made between benchmark resource inventories taken in 1982 and 1987 will show the net effect of government policies and private conservation initiatives. Until the 1987 results are available, estimates of the accumulated effects of specific programs and conservation actions suggest there have been major achievements in reducing soil erosion on cropland in recent years.

CRP Expansion Brings New High in Erosion Prevention

The reduction in long-term average annual erosion from USDA programs newly implemented in 1988 is estimated at nearly 350 million tons (table 17). This reduction plus the continuing erosion prevention on CRP lands treated in 1986 and 1987 should boost the total reduction in annual erosion to the highest level ever for USDA programs. This average prevention excludes any changes in wind or water erosion caused by the 1988 drought.

State, local, and private farmer expenditures on conservation outside of USDA programs also contribute to reduced annual erosion. So also has the expansion in use of conservation tillage. On the other hand, some farmers have been removing or just not maintaining conservation structures because of financial hardship or inconvenience in large scale machinery operations. Also, some farmers may have brought new land into production to partially compensate for land being idled under the CRP and other cropland reduction programs. Even so, the CRP reduction in erosion and other contributions have probably been sufficient to lower average erosion on U.S. cropland to below the 1982 National Resources Inventory (NRI) estimate of 3.1 billion tons annually. Results of the 1987 NRI, when available, should confirm the net reduction.

Including lands coming into the program in 1988, the CRP alone is estimated to reduce average erosion by over 500 million tons. This represents a 145-million-ton additional reduction because of the new lands coming into the program since 1987.

Although the annual acreage reduction programs are for supply control and not specifically designed to reduce erosion, erosion reduction averaging 2 to 5 tons per acre per year does occur from idling cropland. This reduction is much smaller than the 21-ton-per-acre average so far achieved by the CRP on highly erodible lands.

The contribution of the Agricultural Conservation Program (ACP) and the Conservation Technical Assistance Program (CTA) to erosion reduction remains fairly constant. However, the size of the contribution is understated, since available data reflect only the soil savings from newly installed conservation practices. Many practices installed in previous years continue to reduce erosion in subsequent years, but no estimates of this effect are available.

Achievement of a 45-million-acre CRP by 1990/91 could reduce average erosion on contracted lands by 685 - 776 million tons annually during the years the program is in full effect. Over the 15-year life of the program (1986-2000), the accumulated soil savings could exceed 7.5 billion tons.

Agricultural Soil Erosion Could Be Reduced by One-Fourth

Adding to the CRP soil savings beginning in 1990 will be erosion reduction from farmers bringing highly erodible lands not in the CRP into compliance with SCS conservation guidelines. The compliance provision could reduce average erosion by an additional 300 - 500 million tons annually. When the 10-year CRP contracts begin expiring in 1995, land under the program will either continue under permanent cover or have to comply with SCS guidelines if brought into crop production again and the farmer wants to qualify for USDA program benefits. After all conservation provisions of the 1985 FSA are in full effect in the mid 1990's, the average reduction in erosion could exceed 1 billion tons annually. If not offset by negating factors such as changes in agricultural commodity policy, reductions of this magnitude could potentially lower average annual agricultural erosion by one-fourth from that in the early 1980's.

Drought May Affect Erosion in 1988

Generally, lower rainfall reduces the amount of water-caused erosion. However, because of low rainfall early in the growing season in this year's drought areas, normal levels of crop cover did not develop, leaving the soil vulnerable to higher water-caused erosion as well as higher wind erosion.

Additionally, in drought areas, lower crop uptake of applied fertilizer (nitrogen and phosphorous) could result in greater than average amounts of nutrient runoff in 1988. Taking into account the lower water levels that have decreased the assimilative capacity of lakes, streams, and rivers, water quality damages related to agriculture in some areas could be greater in 1988 than in a year with normal weather.

The above indications of soil erosion and nutrient runoff are based on mathematical simulation of the impacts of the drought on crop yields and natural resources, considering actual 1988 weather data and forecasts for the remainder of the year. The model used was the Erosion-Productivity Impact Calculator (EPIC). The model takes into account weather, hydrology, sedimentation, nutrient-cycling, tillage, soil temperature, and other factors affecting a plant's growth environment.

Conservation Generates Economic Benefits

The productivity benefits of soil conservation depend upon the amount of erosion reduction and its value in terms of reducing future crop yield loss and fertilizer use. Estimated benefits from the future productivity of CRP lands when returned to crop production total nearly $780 million (benefits over 100 years discounted to current value) on the annual erosion reduction achieved through 1987 (350+ million tons), and could reach $1.5 billion on the projected annual erosion reduction achieved after full implementation (685-776 million tons).

For the CRP, erosion reduction likely will be greatest in the Southern Plains, Mountain, Northern Plains, and Corn Belt regions. The productivity value on a per-ton basis could vary from $0.17 in the Mountain States to over $0.70 in the Northeast and Lake States. Regions receiving the highest overall future productivity benefits of CRP will most likely be the Corn Belt, Southern Plains, and Lake States.

Productivity benefits of soil loss reduction under other programs have not been estimated.

Crop Yields Sometimes Higher on Conservation Tilled Lands

One beneficial effect of conservation tillage with its fewer tillage operations and increased residue left on the soil surface is enhanced moisture retention. The conserved moisture could improve yields under moisture-short conditions. Conversely, in excess moisture situations the effect on crop yields tends to be negative.

In a 1986 survey of corn and wheat producers about one-fourth of the corn producers and one-third of the wheat producers responding to the survey reported higher yields with conservation tillage than with conventional methods.

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Most respondents who practiced conservation tillage reported no yield change with conservation tillage. Fewer than one-fifth of the corn producers and less than one-third of the wheat producers reported lower yields with conservation tillage. With 1988 drought conditions more extensive than those in 1986, a greater percentage of producers using conservation tillage may experience higher yields than with conventional tillage. Those farmers using conservation tillage even though yields are lower are doing so because soil conservation benefits or lower production costs more than compensate.

Offsite Benefits Likely

The drop in average annual erosion being achieved by the idling of highly erodible land under the CRP and by other conservation measures will decrease sediment and nutrient loadings to water resources over what would otherwise exist. These loading reductions will generate offsite benefits to recreation, water supply, and other water uses, which together will likely exceed the onsite soil productivity benefits of reduced erosion.

However, the fate and transport of chemicals used in agriculture in general and with conservation tillage in particular have become a national concern. (See water section of this report.) Under some soil management conditions, conservation tillage with its higher rate of moisture retention and infiltration could further the leaching of pesticides and fertilizer nutrients into ground water. In critical areas, increased monitoring of ground water and implementation of improved nutrient and pesticide management may be needed.

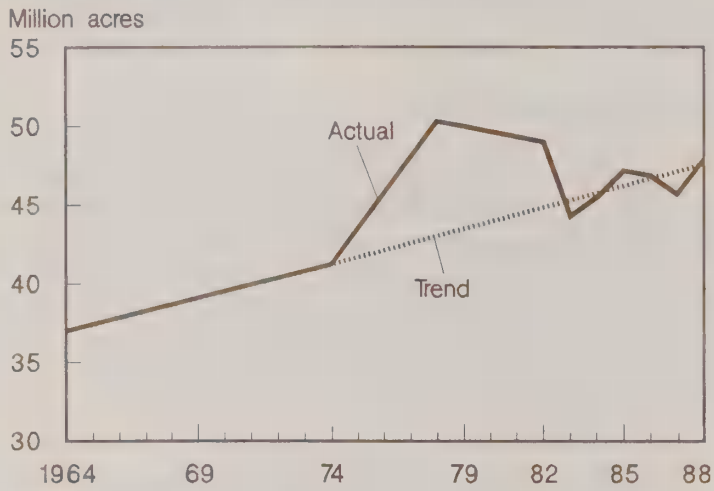
WATER

Irrigated farms make a significant contribution to total agricultural production under normal weather conditions but have even greater importance when drought affects areas dependent on seasonal rainfall. Normally about 30 percent of the value of U.S. crop production comes from the 13 percent of U.S. harvested cropland that is irrigated. This share of crop value is expected to be even higher in 1988 because of lower production in the large drought affected area. Irrigated farms tend to have more acres, higher yields, and use more inputs than nonirrigated farms. Also the risk of low yield or crop failure is nearly eliminated on irrigated land because of less dependence on timely rainfall during the growing season.

While irrigation makes agriculture an important sector in many regions, its large use of water competes directly with urban and industrial growth objectives in arid or semi-arid areas. Irrigation takes over 97 percent of all water used in agriculture and about 35 percent of water used for all purposes in the United States. The allocation of water between agriculture and other major uses is an issue in many policy questions.

Interest in current irrigation estimates comes from many sources. Equipment manufacturers and dealers are interested

Figure 12
Irrigated Land in Farms, 1964-1988



Source: (3,4)

because irrigated farms are intensive users of production inputs. They are more highly capitalized than nonirrigated farms, with more than twice as much invested in land, buildings, machinery, and equipment. Agricultural chemical producers and suppliers know that irrigated farms use more than twice the fertilizer and three times the pesticides of nonirrigated farms. Energy and water planners and those alert to the needs of migrant labor are concerned because irrigated farms use three times as much energy and five times as much labor as the average nonirrigated farm. Commodity forecasters are also interested because irrigated farms produce four times the value of crops per farm and twice as much livestock. Therefore, policymakers, planners, irrigation analysts and others have need for up-to-date estimates of irrigated acreage trends and regional changes. Yet, the most reliable data are available only from the U.S. Census of Agriculture at 5-year intervals and may be as much as 6 years old before new data are available.

This section presents a new series of estimated irrigated acres and examines annual variations from long-term trends. The series provides some insight on how, in recent years, agricultural regions differed in their response to economic and policy actions that had short-term affects on irrigation.

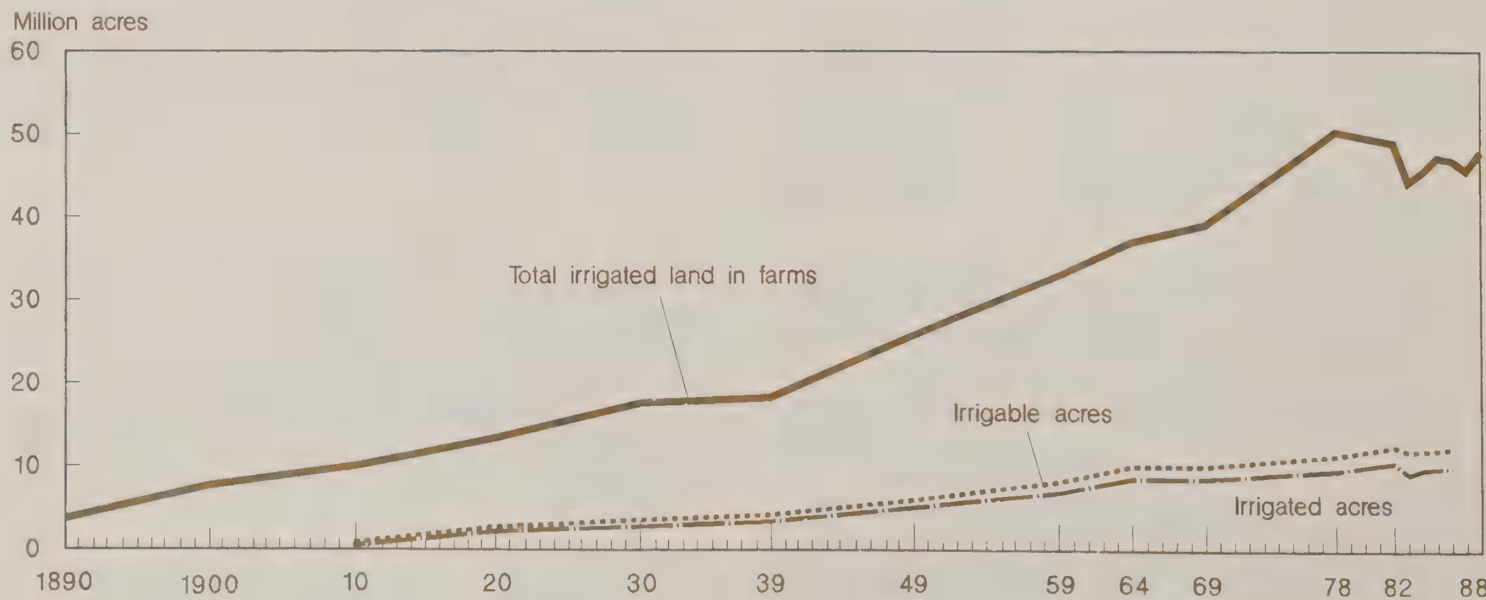
Aggregate Trend Masks Annual Changes

In this century, irrigated land in farms has increased at an average annual rate of just under one-half million acres. The record area irrigated peaked in 1978 at 50.3 million acres (figure 12). Prior to reaching this peak, the rate of increase departed from its historic trend with irrigation increasing over 9 million acres between 1974 and 1978. This departure was soon reversed.

The 1982 Census of Agriculture, reporting a small decline in irrigation, suggested that the accelerated trend was not sustainable and raised doubts that irrigation development could continue as long as energy prices remained high. The 1984 Farm and Ranch Irrigation Survey reported irrigated area down to 44.7 million acres and raised the question whether the long history of irrigation expansion may come to a close.

Annual USDA estimates of irrigated area in the 1980's indicate the low point was reached in 1983 when irrigation declined 4.7 million acres to 44.3 million. Since then the area has trended up reaching 47.9 million acres in 1988. The

Figure 13
Growth in Irrigation, 1980 - 1988



Source: (3,6,9)

Table 18.--Irrigated acreage by farm production region, 1969-88

Region	1969 1/	1974 1/	1978 1/	1979 2/	1982 1/	1983 3/	1984 3/	1985 3/	1986 3/	1987 3/	1988 3/
					Million acres						
Northeast, Appalachian, & Southeast	1.8	2.0	2.9	2.8	2.7	2.6	2.3	2.2	2.1	2.3	2.2
Lake States & Corn Belt	0.5	0.6	1.4	1.4	1.7	1.8	1.5	1.6	2.0	1.9	2.2
Northern Plains	4.6	6.2	8.8	9.0	9.3	8.0	8.9	9.2	9.3	8.3	8.1
Delta States	1.9	1.8	2.7	2.5	3.1	2.3	2.5	2.1	2.5	2.9	3.3
Southern Plains	7.4	7.1	7.5	7.3	6.1	5.5	5.8	5.9	5.6	5.4	6.2
Mountain	12.8	12.7	14.8	14.7	14.1	12.8	13.2	13.5	12.3	12.3	13.1
Pacific	10.0	10.6	12.0	12.1	11.9	11.1	11.2	12.4	13.0	12.5	12.6
United States 4/	39.1	41.2	50.3	50.0	49.0	44.3	45.5	47.2	46.9	45.7	47.9

1/ Census of Agriculture. 2/ 1979 Farm and Ranch Survey adjusted for excluded specialty farms with Census. 3/ ERS estimates based on 1984 Farm and Ranch Survey, 1983-88 JES data (unpublished), and annual data on crops that are mostly irrigated. 4/ Includes Alaska and Hawaii.

average annual rate of increase during 1974-88 is nearly equal to the long-run trend (fig. 13).

The national trend in irrigated acreage may continue to be useful as an indicator of long-run changes due to technological adoption but masks important regional differences. The trend also masks year-to-year fluctuations due to variations in crop prices, energy prices, commodity programs, and drought. Annual estimates of irrigated area are beginning to reveal which factors appear most influential and will dominate other factors when found in combination.

Crop Prices Strongly Influence Irrigation

The U.S. irrigation totals strongly suggest that crop prices and acreage reduction programs are more influential on area irrigated than drought conditions or energy prices. After expanding 30, 34, and 31 percent in the first three decades of this century, irrigation development slowed to 4 percent in the 1930's (figure 13). This period was marked by low crop prices. The more prosperous decades of the 1940's and 50's again encouraged irrigation growth.

The 1974-83 period also stands out as another substantial deviation from the trend, this time with exceptionally favorable crop prices inducing development at about 2.3 million acres per year between 1974 and 1978. The 1978-83 period reflects an adjustment to the more typical situation of chronic surpluses and low prices. Estimates for 1983-88 remain clustered about the trend line for 1964-74, a similar period of excess capacity and low prices.

Acreage Reduction Programs Affect Irrigated Area

The most striking feature of the annual data is the decline which took place in 1983 when irrigation dropped by 4.7 million acres. Record high idle acreage under Federal programs overwhelmed any increased irrigation due to drought in the Corn Belt that year. The 67-million-acre increase in idle cropland was more than twice that of any other year. The only other significant drop (1.2 million acres) in annual irrigation totals occurred in 1987, the year with the second highest increase in cropland idled under Federal programs (28 million acres). Conversely, declines in idle cropland from annual programs in 1984 and 1988 are coincidental with increases in commodity prices and irrigated land in farms. However, there is a limit to the amount of new irrigation that can be brought on-line in a short period of time. Strong short-term growth comes from previously idled equipment.

Regional Estimates

Although year-to-year changes in the national total suggest that irrigation is determined by crop prices and acreage reduction programs, a look at regional estimates suggests that drought conditions and energy prices can have a significant effect locally.

No region's irrigation replicates the national pattern (table 18). However, the Pacific and Mountain regions follow the pattern closely. They account for just over one-half of U.S. irrigated acreage. In the Pacific region, irrigated acreage continues to increase, with about one-half million more acres irrigated in 1985-88 than in 1978-82. Irrigation in the Mountain States followed the national pattern except for a slight dip in 1974 and a larger dip in 1982. Both the Pacific and Mountain regions are arid with some areas of supplemental irrigation. For the most part, however, irrigation is required every year. Western States receive very little rain in summer months compared to Eastern States.

The Plains States straddle the generally recognized demarcation between the arid West and the humid East. The Northern Plains rely extensively on natural gas as an energy source for irrigation systems. This region was the site of the Nation's most rapid expansion of irrigation between 1969 and 1982. If increasing energy prices were having an effect, it was lost in the wave of technological adoption. As in other regions, the commodity programs for 1983 and 1987 were economically attractive and resulted in substantial reduction of irrigated acreage.

Energy Costs Affect the Southern Plains

Crop prices, diversion requirements, and energy costs are important factors explaining annual fluctuations in irrigation in the Southern Plains. About one-half of the area is irrigated with energy from natural gas. Intrastate natural gas prices first began to accelerate in 1971, more than quadrupling between 1970 and 1975. A similar acceleration occurred following deregulation in 1979 when gas prices tripled within a 2-year period. Because much of the irrigation water in the Southern Plains has been pumped from deep and declining water tables, energy costs represented a substantial share of production costs. Areas irrigated in 1974 and 1982 were reduced accordingly.

Since 1982, natural gas prices have been relatively stable with slight declines in recent years, and irrigators have actively adopted more efficient irrigation technology to cut pumping costs. Other regions that depend less on natural gas and more on electricity have not experienced such sensitivity to energy prices. The regulatory atmosphere of the electric power industry results in energy price shocks being spread out over several years.

Within the Delta States, Arkansas and Louisiana also depend on intrastate natural gas as an energy source, but acreage reduction under the rice program is the dominant factor. Rice accounts for a large share of acreage irrigated. Rice planting is determined primarily by base acres and by acreage diversion requirements for eligibility to receive deficiency payments. Almost half of the U.S. rice acreage was idled under government programs in 1983, and irrigated land in the Delta dropped by one-fourth. In 1988, with rice diversion acreage down and planted area up by 300,000 acres over 1987, area irrigated reached a new high of 3.3 million acres.

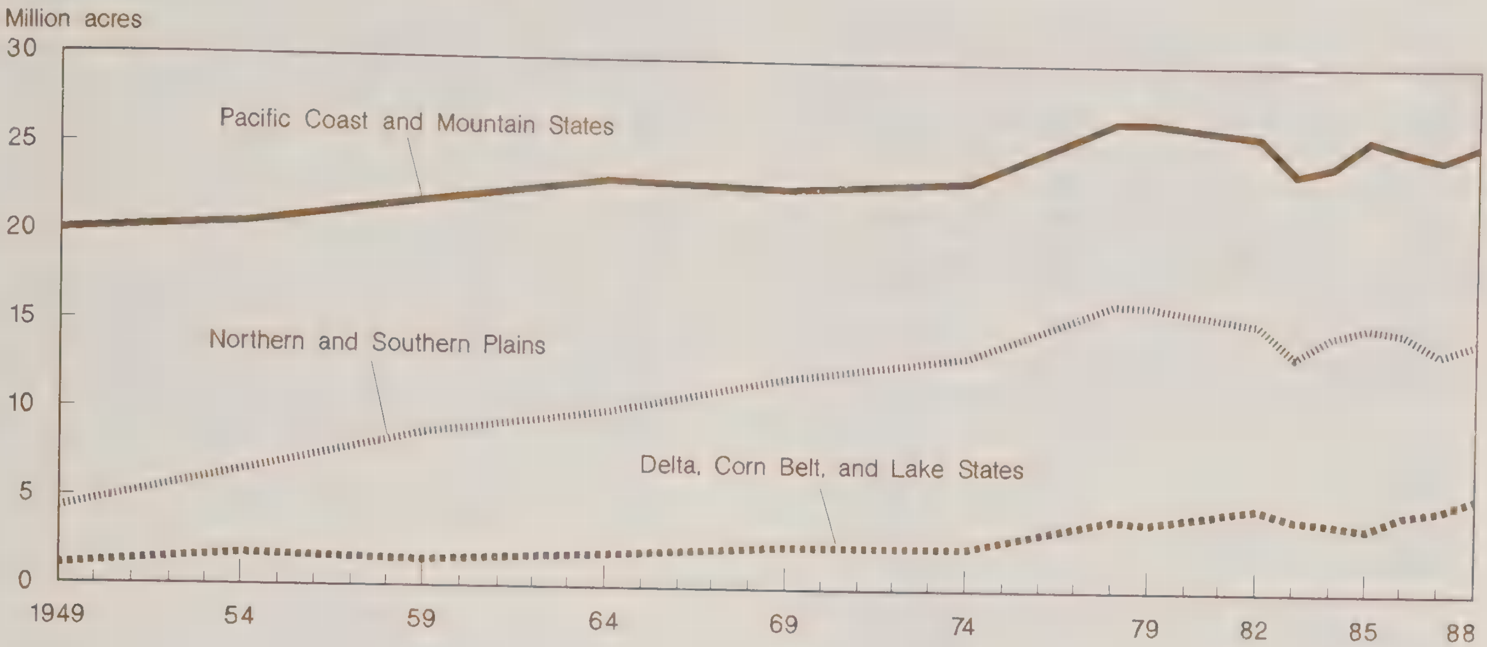
Table 19.--Growth in irrigation development, total acres and U.S. Bureau of Reclamation share, 1900-86

Year	Total irrigated acres	Bureau of Reclamation: Irrigable acres	Bureau of Reclamation: Irrigated acres	Bureau of Reclamation: Irrigated as percent of irrigable acres	Bureau of Reclamation: Bureau as percent of total irrigated acres
	Million acres	Million acres	Million acres	Percent	Percent
1900	7.7	--	--	--	--
1910	10.0	0.9	0.5	52	5
1920	13.4	2.8	2.2	78	16
1930	17.6 1/	3.6	2.8	77	16
1939	18.3 2/	4.2	3.4	81	19
1949	25.8	6.0	5.1	84	20
1959	33.0	8.2	6.9	84	21
1969	39.1	10.1	8.6	85	22
1978	50.3	11.4	9.6	84	19
1982	49.0	12.5	10.6	85	22
1983	44.3	11.9	9.2	78	21
1984	45.5	12.0	9.8	81	22
1985	47.2	12.1	9.9	82	21
1986	46.9	12.3	10.0	81	21

1/ Includes 14.6 million acres of crops harvested in 19 States as reported by Census of Agriculture plus a 3.0-million acre adjustment to account for irrigated pasture, other irrigation, and irrigation in other States (reported as 3.2 million acres in 1939). 2/ Includes 0.3 million acres reported by Census of Irrigation as irrigated but not harvested and not pastured.

Source: (3, 6, 9)

Figure 14
Irrigation Development Moves East



Drought Affects the Corn Belt

The fastest rate of growth in irrigation development is now found in the Corn Belt and Lake State regions where irrigation has more than quadrupled since 1969. Unique to these regions is strong evidence that weather can affect acreage irrigated. The high idled acreage from Federal programs in 1983, along with low crop prices, led to substantial reductions in irrigated area throughout all other regions. But the Corn Belt experienced drought and all existing irrigation equipment appears to have been kept in use that year. Irrigation is supplemental in the humid East, used when and if needed. It was needed in 1983 when producers irrigated a record 1.8 million acres. In 1988, as in 1983, the drought has contributed to a record area irrigated, 2.2 million acres.

Growth in Irrigation Development

In 1900, 7.5 million acres were already irrigated, or about 1 percent of the 839 million acres in U.S. farms. Irrigated farms had an average of 70 irrigated acres and produced about $12 per acre in crop value (about $100 per acre in current dollars). Since then, the averages have grown to 211 acres per irrigated farm and $530 in product value per acre. Irrigation reached a high of 50.3 million acres in 1978 (figure 13), or 5 percent of the 1.104 billion acres of land in farms.

Federal Projects

Under the 1902 Reclamation Act and other legislation, the Federal Government has planned and constructed irrigation and multipurpose water resource development projects. While some Federal irrigation development existed prior to 1900, the bulk of it has occurred since then. The Bureau of Reclamation has been responsible for most Federal irrigation development, accounting for about 22 percent of U.S. irrigated acres in 1969 (table 18).

With the downturn in total irrigated acres through 1986, the proportion supplied by the bureau is again on the rise. (see the special article by Moore and McGuckin later in this report). Although no new Federal irrigation development projects have been authorized since 1976, the bureau continues to add capacity through the completion of components previously authorized. This process has been slowed primarily by budget restrictions and pressures to leave the remaining water instream for other uses.

The bureau classifies lands in its service area as irrigable and irrigated. Irrigable acreage either has project works constructed and water available or existing plans to provide them. Irrigated acres are the irrigable acres actually irrigated in any year. The difference between the two measures indicates future growth potential. Recently, the bureau has been operating in the low to mid 80 percent of potential irrigation capacity (table 19).

Eastward Progression

After World War II, irrigation about doubled in the 48 conterminous States. Federal development of subsidized surface water for irrigation was a major factor in the Pacific and Mountain regions (figure 14). Recently, growth has slowed as public support for new irrigation development has waned and available reservoir sites have become scarce. No new Federal projects have been authorized during the past two administrations and several have been effectively terminated.

Table 20.--U.S. Bureau of Reclamation irrigable and irrigated acres, by States, 1985-86 1/

State	Irrigable acreage 1985	Irrigable acreage 1986	Irrigated acreage 1985	Irrigated acreage 1986	Difference between irrigable and irrigated 1985	Difference between irrigable and irrigated 1986
			1,000 acres			
Arizona	518	518	281	293	237	225
California	4,092	4,210	3,178	3,214	914	997
Colorado	1,297	1,359	1,126	1,197	171	162
Hawaii	14	14	4	4	10	9
Idaho	1,687	1,687	1,492	1,473	195	213
Kansas	73	66	31	48	41	18
Montana	402	425	348	372	54	53
Nebraska	539	546	496	503	43	44
Nevada	221	221	167	168	54	53
New Mexico	279	279	210	205	69	74
North Dakota	38	36	31	30	7	5
Oklahoma	47	47	36	36	11	11
Oregon	534	534	470	463	64	71
South Dakota	80	81	74	73	6	8
Texas	331	331	240	240	91	91
Utah	452	452	366	361	86	91
Washington	1,065	1,065	945	917	120	148
Wyoming	423	423	386	381	38	42
Total	12,092	12,294	9,882	9,980	2,211	2,315

1/ Table values were rounded separately and may not add.

Source: (9)

Also, growing competition from hydroelectric power, municipal, and industrial water users for the scarce and increasingly expensive water makes it unlikely that much expansion potential exists outside of previously authorized projects in the Western regions.

Irrigated acreage expanded in response to favorable economic and water supply conditions and commodity prices during the 1950's, 1960's, and 1970's. This was particularly true in the Northern and Southern Plains regions, where advances in pump technology and adoption of center pivot irrigation technology spurred growth in privately developed ground water irrigation. But this growth was supported by abundant use of ground water, mainly from the Ogallala aquifer. Because of limited recharge, the Ogallala in the Southern Plains could not sustain such use without ground water declines. Limits to ground water supplies, higher pumping costs due to greater lifts and higher energy prices, and declining commodity prices brought a halt to irrigation development in the Southern Plains.

Irrigation in the humid Eastern regions, although still a small proportion of humid area agriculture, has experienced rapid and sustained growth during the last three decades. Corn, soybean, and rice irrigation contributed to this growth, along with fruit, vegetables, and other horticultural specialty crops. Income from these crops contributes significantly to the rural economies of some regions. Unlike the Western regions, surface and ground water appear ample for continued development. Over 70 percent of the humid area irrigated acreage is currently located in the Southeast and Delta States. Other potential Eastern growth areas appear to be the Lake States and Corn Belt. However, State water management plans in some Eastern States give water managers authority to reallocate use under serious water shortages. Thus, in severe droughts, irrigators may be required to share or diminish their use at a time when they need water the most.

The Irrigation Outlook

Added capacity in existing Bureau of Reclamation projects, adoption of cost-cutting water conservation measures, energy and crop prices, participation in farm programs, and weather patterns all can influence the area of irrigated land in farms.

No significant new bureau water supply projects are anticipated in the near future. Capacity to supply water continues to increase slowly due to completion of already authorized projects (table 20). This potential for growth in surface-supplied irrigated acreage could amount to an increase of about 20 percent in the bureau supported irrigation but will probably not be realized because other claims exist for some of the water. Nearly half of the uncompleted potential is located in California where the greatest number of irrigated acres already exist.

Irrigators will continue to increase the efficiency of their systems. To cut costs, many farmers have adopted water saving technologies, which deliver water when and where needed and keep acres in irrigation that would be idled for cost reasons. Some have installed drip and trickle irrigation systems, which provide a 90-percent-plus efficiency by delivering water directly to the crop's root zone.

Table 21.--Current and potential enrollment of irrigated acres in the Conservation Reserve Program

Region	Enrolled irrigated cropland	Potential irrigated acres in the CRP by 1990: Historical enrollment rate 1/	Potential irrigated acres in the CRP by 1990: Reduced enrollment rate 2/
	1,000 acres		
Pacific	12	22	17
Mountain	66	114	89
Northern Plains	125	230	178
Southern Plains	220	409	315
Total for 17 Western States	423	775	599

1/ Assumes that irrigated acres will continue to enter the CRP at the rate they have entered prior to September 1987, but with an upper limit set at those ground water acres for program crops with pumping lifts greater than 200 feet. 2/ Assumes that irrigated acres will enter the CRP at half the historical enrollment rate.

Source: (7)

In those areas experiencing severe ground water declines, such as the Texas High Plains, irrigation costs have been climbing rapidly and have caused some areas to shift to dryland farming. Many farmers in the Texas High Plains have installed center pivot sprinklers equipped with drop lines, which have an average water application efficiency of 80 to 90 percent. Most of these systems were installed on previously furrow-irrigated land, where efficiency ratings were about 60 percent. As a result, aquifer levels have reversed a long-term decline during the past 3 years and by 1987 had experienced a rise of nearly a foot. As more farmers adopt these practices, energy and water requirements per acre irrigated will decline further and profitability will increase.

In the past, doubling and tripling energy prices caused some decisions not to irrigate. Such price swings have not occurred in recent years, nor are they likely in the near future. In general, energy prices peaked around 1985 and have since declined. The effect of such a decline in combination with the increased efficiencies, will be primarily to halt and perhaps to regain some of the losses of irrigated area in the Southern Plains. The substantial gain in this region for 1988 may be due, in part, to reduced energy costs and the ability to bring previously idled systems back on-line.

Crop prices appear to be the most influential factor determining changes in irrigated area. In contrast to 1984, when a surge in prices for the 1983 crop came principally from the 1983 drought and large acreage diversion program, the surge in prices for the 1988 crop rests partially on expanding CRP acreage and export demand, which are expected to continue as factors in the near future. The 1990 goal for the CRP is to have 45 million acres enrolled. As long as the trade deficit persists there will be downward pressure on the dollar and a favorable outlook for export demand. The progress of GATT negotiations and the possibility of further trade liberalization add to the optimism about prices.

Commodity programs explain many year-to-year swings in irrigated area. Idle acreage under government programs peaked in 1983 and in 1987. These years are also low points of the irrigation trend. The effect is particularly noticeable in years when the incentive to participate is very high and in areas where the program crops are mostly irrigated. To receive deficiency payments, participating farmers must set aside irrigated cropland. With the CRP commitment, higher prices, and reduced stocks in 1988, the 1989 program will likely involve a further reduction in annual diversions. If expanding export markets are to be maintained, the increase in planted acres could be substantial.

Participation by irrigators in the CRP during the first five sign ups is estimated at 0.4 million irrigated acres out of the 22 million acres enrolled (table 21). If irrigators continue to sign up at their present rate, total enrollment would only reach 0.8 million acres out of a planned 45 million by 1990. This is insignificant in terms of total irrigated acres. Over half of the irrigated acres enrolled, however, would be located in the Southern Plains region where many irrigation systems are nearing the end of their useful lives and farmers are contemplating a shift to dryland. The CRP program could actually be helping those affected farmers make the transition.

Droughts seldom affect an area for more than a year. However, they often kindle a strong desire among affected nonirrigators to adopt irrigation technology. Similarly, they spark a desire among irrigators to adopt more efficient water application methods. Droughts also leave a concern about water supplies.

The 1988 drought has focused attention on the irregular global warming trend through this century and on the discussion that part of this warming may be linked to increases in manmade greenhouse gases discharged into the atmosphere. Numerical models suggest that this warming trend will continue, and possibly accelerate in the near future. However, there is still a degree of uncertainty as to the magnitude and distribution of the expected change. It is clear that farmers will be focusing even more on the economics of irrigation and managerial changes due to the recent greater variability in observed weather patterns.

The 1987 Census of Agriculture estimates of irrigated acres will provide benchmarks for measuring the long-run trend and assessing the ERS annual estimates. Validity of the selected variables in explaining annual variations will also be sought from these data.

Policies and Legislation Affecting Agriculture and Water Quality

The laws and regulatory policies that deal with agricultural nonpoint source pollution of surface water and ground water may be grouped into three general categories. First, a variety of Federal farm programs have direct or indirect impacts on water quality. Second, several key environmental statutes have implications for the farm sector: regulations or new legislation to achieve environmental goals could in turn affect farming practices and crop production. Finally, several State policies address local concerns not met by Federal laws and regulations.

Water Quality Improvement from Federal Farm Programs

The main Federal farm programs relating to water quality are part of the 1985 FSA. The two most significant provisions are the Conservation Reserve Program (CRP) and the Conservation Compliance provision. The CRP is one of the first Federal agricultural programs in which enhancement of water quality was explicitly identified as a goal. Recent modifications have made this connection even stronger, as filter strips along lakes and streams are now eligible for the CRP, even if the land is not highly erodible. The CRP sign ups to date have contributed to surface water quality by reducing the net inflow of nutrients, sediments, and pesticides to lakes and streams. (See the Conservation Section for details.)

Other USDA conservation programs affect water quality, although they are instituted for more traditional goals, such as maintaining soil productivity. By reducing soil erosion and runoff from cropland, the conservation measures reduce agricultural chemicals entering water bodies. Future implementation of the Conservation Compliance provisions of the FSA also can be expected to contribute to overall surface water quality.

Nonagricultural Programs Affect Production

A variety of nonagricultural water-quality legislation and policy initiatives also affects commercial agriculture. Here, the direction of policy is reversed. Rather than being a secondary or residual effect of a program, protection of water resources is the policy objective and agriculture will be directly affected.

The 1987 Water Quality Act, which is a successor to Federal water pollution legislation enacted in 1972 and 1977, for the first time explicitly deals with the problem of controlling nonpoint source pollution. The significance for agriculture lies in the fact that agricultural nonpoint sources of pollution are likely to be among the main targets of nonpoint pollution control efforts by the States under this Act. As part of their water management strategies, States may encourage or require the adoption of alternative tillage practices to reduce runoff, impose land use restrictions in environmentally sensitive areas such as critical recharge areas for aquifers, restrict the type of agricultural chemicals used or their application, or impose taxes or fees on agricultural chemical use.

While the 1987 Water Quality Act is aimed primarily (though not exclusively) at protecting surface water resources, other Federal laws and policies also address the problem of ground water contamination. The Federal laws most directly applicable to ground water contamination from agricultural residuals are the Safe Drinking Water Act of 1985 and the Federal Insecticide, Fungicide, and Rodenticide Act of 1949.

Provisions of the Safe Drinking Water Act allow the Environmental Protection Agency (EPA) to set "maximum contaminant levels" for drinking water. Currently 22 contaminants are regulated, and amendments enacted in 1986 provide for the regulation of another 61 substances. Maximum contaminant levels apply only to public wells and not to private wells. The Act also calls on States to develop "wellhead protection programs" to prevent ground water contamination. States are responsible for implementing these programs with some Federal financial and technical assistance. However, Congress has not yet appropriated funds for wellhead protection.

The Federal Insecticide, Fungicide, and Rodenticide Act provides the legal basis for pesticide registration, re-registration, marketing, and use. EPA requires information about the leachability of pesticides before registration or re-registration. Recent proposals to amend this law would establish guidelines under which pesticide use would be restricted or canceled. These proposed guidelines would be based on the concept of "trigger levels" for ground water contamination by pesticides. If pesticide residues were found to exceed maximum contaminant levels then the States or EPA would take corrective action. This could include changing the registration to restrict use or remove the chemical from the market.

The EPA has recently proposed a major policy initiative to protect ground water from pesticide contamination (11). The earlier (1984) overall ground water protection strategy defines three classes of ground water: Class I --Critical (highly vulnerable to contamination or irreplaceable), Class II --Current or potential use as drinking water supply, and Class III --No current or potential use for human consumption due to natural or manmade contamination. Different levels of protection apply to each class of ground water, with lower levels of contamination allowed in Classes I and II.

Consistent with the overall strategy, the EPA proposes differential protection depending on the value and use of the resource, and relies on States to make decisions on what

ground water falls into what category. Thus when concentrations of harmful chemicals exceed some defined level (perhaps 50 percent of the maximum contaminant level) actions are taken to restrict or modify use of that chemical, an action termed "yellow light." There will be a continuum of increasingly stringent action to bring the pesticide exposure into conformance with the goal. A key component in this continuum will be the use of State management plans to identify specific management approaches (rate, timing of application, no-use zones, best management practices, etc.) for leaching pesticides. If pesticide residues cannot be brought into an acceptable range through any management mechanism, the EPA will likely move to cancel the pesticide, an action termed "red light." This proposed strategy has been published for public comment, and the Agency is working toward a final strategy.

State Programs for Water Quality Also Affect Agriculture

States are taking different approaches to deal with agricultural impacts on water quality. Currently 36 States have enacted some form of legislation dealing with pesticides in ground water, and 11 States have enacted legislation dealing with fertilizers. California, Florida, New Jersey, Iowa, and Minnesota are among the States most actively pursuing ground water protection programs. Some States have proposed levying taxes on agricultural chemicals. Others have emphasized increased educational programs and voluntary efforts to promote such practices as conservation tillage and reduced input use.

Impacts of Water Quality Policies on Agriculture

Public policies to protect water quality can have economic effects on agriculture. To comply with various State, Federal, and local laws, farmers in critical watersheds may face restrictions and higher production costs. They may be required to implement management practices to reduce soil erosion and nutrient runoff, restrict or limit the use of highly leachable pesticides, or pay higher taxes on certain fertilizers and pesticides.

Any of these actions could affect farm operations. Fertilizer and chemical use may be reduced as farmers modify cropping practices and substitute less polluting inputs. Structures may have to be built to reduce runoff and prevent pollutants from entering surface or ground water. Tillage practices may change as more farmers adopt reduced or no-till methods. Crop rotations may also change, as farmers are encouraged to include meadow or less erosive crops in their rotation. It is also possible that participation in Federal commodity programs may change if farmers decide to forgo program benefits rather than meet the conservation compliance requirements under the 1985 FSA.

Responses by farmers to water quality programs could affect the economic performance of the farm sector. Crop yields could decrease if fertilizer use is reduced or if widely used pesticides are banned without an equally effective substitute. Weed control may be achieved by additional cultivation, but only at the expense of higher labor, machinery, and fuel costs. Also, the lost revenue from decreased yields could be partially offset by increased prices and potentially lower overall input costs. The net impact on farmers of restrictions on agricultural chemical use or tillage practices will depend upon the extent to which the production input mix can be efficiently adjusted.

The degree to which water quality programs will affect total farm sector income will depend on several factors. If steps taken to protect water quality are only in environmentally sensitive watersheds, and if the crops affected are already in surplus, then the decreased income would be confined to those local areas. On the other hand, if environmental policy is nationwide, such as a total ban on a widely used pesticide, the effects on the farm sector and on consumers would be more widespread.

The effects of water quality programs will vary across farms as various protective measures are adopted. Those farms in an environmentally sensitive watershed, or that contribute to a nonpoint source problem, will be affected more than others. This could result in some differential impacts of water quality programs on farm costs and returns between regions, especially if environmental laws and regulations are applied in different ways in different locations.

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ECONOMIC AND PHYSICAL MARGINALITY OF HIGHLY ERODIBLE CROPLAND

by
Ralph E. Heimlich

Abstract: Highly erodible land can also be highly productive. Such lands may have high opportunity costs for retirement. Large incentives may be required to induce farmers to retire highly productive, highly erodible land

Keywords: productivity, erodibility, marginal cropland, soil erosion, crop yield, resource policy.

Current agricultural policy, through the conservation reserve and conservation compliance provisions of the Food Security Act of 1985, seeks to retire highly erodible land or deny farm program benefits to operators who crop such land. Highly erodible land is not necessarily unproductive. In fact, productivity on highly erodible land varies in nearly the same way as productivity for all cropland. Thus, on highly erodible land with high productivity, meeting conservation reserve enrollment targets and compliance objectives may have high opportunity costs for farmers and society. This article reports on an empirical study of the relationship between soil productivity and erodibility (3). The outlook for soil erosion control policy, in light of these findings, is examined.

Physical and Economic Marginality

Recent policy has identified highly erodible land as physically marginal land that should be retired from crop production. Other physical conditions considered marginal for crop production include soil compaction, salinity, and hydric regime, but policy analysis has not singled out these conditions. The term "marginal land" is used by both physical scientists and economists to denote two different concepts.

Soil scientists and agronomists focus on physical attributes of land that limit its usefulness for sustained crop production. Properties such as soil moisture, texture, acidity, depth, slope, porosity, organic matter content, temperature, and nutrient-holding capacity figure prominently in physical assessments of soil resources (7).

In contrast to the physical view of resource marginality, economic theory suggests that factors of production, including land, will be used in a competitive environment as long as the marginal benefits from use exceed the marginal costs (6, p. 546). Land producing low crop yields under conventional technology can become economically marginal if crop prices decrease or production costs increase, even if physical limitations do not prevent its use for crop production.

Conversely, even land with severe physical limitations for long-term crop production may be farmed at a given crop price if returns are sufficient to cover variable cash costs of production in the short run. Different land resources may be at the economic margin of use at different times because crop prices, production costs, and technology change over time.

Correlation Between Productivity and Erodibility

In this study, soil productivity is measured by both corn grain yields and estimated net returns from production of major field crops on nonirrigated U.S. cropland. For details, see the accompanying box. Profitability is a more useful measure of economic productivity than corn grain yield because returns can be estimated for over 99 percent of nonirrigated cropland, while 33 percent did not have an estimated corn grain yield. On the other hand, profitability may reflect differences in commodity program impact across crops or regions that are not associated with true productivity.

Statistically, neither measure of productivity is closely related to soil erodibility, as measured by factors of the Universal Soil Loss Equation (USLE) (table 1).[1] The productivity of soils with high inherent erodibility may be higher, lower,

Table 1--Correlation matrix and statistics for U.S. nonirrigated cropland productivity and erodibility, 1982

Variables	RKLS/T	Corn yield	Net crop revenue
RKLS/T 1/	1.000	-	-
Corn yield	-.110	1.000	-
Net crop revenue 2/	-.059	.337	1.000
Units	na 3/	bu/ac	$/ac
Mean	6.19	92.15	6.66
Minimum	0	40.00	-254.14
Maximum	1,535.56	163.00	246.57

- = Symmetrical entries across the main diagonal of the matrix. 1/ Continuous variable computed using USLE parameters at each 1982 NRI sample point. 2/ Simple average of net returns to crop production for eight program crops (yield times season-average price, minus variable production cost) at each 1982 NRI sample point. 3/ The erodibility index is dimensionless since both RKLS and T are measured in tons per acre per year.

[1] Highly erodible cropland is defined for USDA programs as having an erodibility index (EI) of 8 or more, versus the limit of 15 used here (see box). This study focuses on the most highly erodible land.

or the same as that of soils with lower inherent erodibility. Corn grain yield and estimated net returns are only weakly correlated. Part of the difference between corn yield and net return occurs because yields of other crops are not directly proportional to corn yield. Production cost differences also contribute to net revenue variations that are not proportional to crop yield.

Highly Erodible Land Can Be Profitable

A simple cross-tabulation reveals the amount of cropland with each possible combination of soil erodibility and profitability (table 2). Results based on estimated net revenue under 1982 conditions show that the profitability of highly erodible land is distributed in much the same way as the profitability of all nonirrigated cropland. The percentage of highly erodible land in the most productive class for 1982 (more than $50 per acre net revenue) is almost equal to that of nonerodible land, while a smaller proportion falls in the least productive class (more than $25 loss per acre).

Moderately erodible land is proportionally more productive than either nonerodible or highly erodible land. The largest absolute amount of highly productive cropland is moderately erodible. Wind erodible land is not defined on the same basis as the other classes and should not be compared with them (see box).

These results hold for nonirrigated cropland at the national level. In specific States or regions, more highly erodible land may be unprofitable than less erodible land. Land that is not profitable relative to other land in one region may be as profitable as the best land in another region. When aggregated at the national level, however, such regional differences wash out. The national distribution of profitability affects national policies for highly erodible land, not regional profitability distributions.

Highly erodible land may also be highly profitable. Only 37 percent of cropland with high returns (more than $50 in 1982 estimated net revenue) is nonerodible, while 9 percent is highly erodible. On the other hand, only 9 percent of cropland with appreciably negative returns (estimated losses greater than $25 per acre) is highly erodible, while nonerodible land makes up 37 percent of unprofitable land.

Cropland profitability in all erodibility classes overlaps significantly (See figure.). Knowing that a field is highly erodible provides no indication of its profitability relative to less erodible land, since the profitability of highly erodible land is distributed across virtually the same range as that of nonerodible land. Similarly, knowing a field can produce positive net returns gives no indication of its inherent tendency to erode relative to less profitable land.

Outlook for Policy

Roughly the same proportion of highly erodible soils is highly productive as for all cropland soils. This finding has general implications for highly erodible land policy:

o Land retirement and erosion control programs can be expected to only retire highly productive, highly erodible land at higher cost or larger outlays.

o Better land classification systems or more extensive use of existing soil information could improve the basis for policy design and implementation.

Policy and program decisions designed to affect use of erodible land cannot presume that this land has low opportunity costs. While erodible land may or may not earn lower revenue over the long term, the decision to restrict production in the short term must reflect current productivity. Idling highly erodible land may mean idling some productive cropland. If so, retirement incentives for such land may have to be correspondingly large.

Specifically, the Conservation Reserve Program (CRP) and conservation compliance provisions of the 1985 Food Security Act are designed to remove highly erodible land from production and require erosion control on highly erodible land in order to be eligible for farm program benefits. It is possible that highly erodible land examined in

Table 2--Distribution of nonirrigated cropland by nonirrigated net crop revenue and erodibility, 1982

Net crop revenue per acre	Erodibility Class				
	Non-erodible	Moderately erodible	Highly erodible	Wind-erodible	All cropland
Dollars per acre			Thousand acres		
More than $ 50 profit	22,684	32,110	5,445	1,482	61,722
$ 25 loss to $ 50 profit	63,890	94,389	18,140	24,117	200,535
More than $ 25 loss	35,674	23,155	8,683	29,062	96,574
All 1/	122,247	149,654	32,668	54,661	358,831
			Percent		
More than $ 50 profit	18.6	21.5	16.9	2.7	17.2
$ 25 loss to $ 50 profit	52.3	63.1	56.2	44.1	55.9
More than $ 25 loss	29.2	15.5	26.9	53.2	26.9
All	100.0	100.0	100.0	100.0	100.0

1/ Wind erodible land is classed separately because wind erosion equation parameters were not available to calculate the appropriate wind erodibility index (see box). Wind erodible land is not comparable to other erodibility classes.
2/ Excludes 2.1 million acres of nonirrigated cropland with no estimated yields and 60.5 million acres of irrigated cropland. Columns may not add to totals due to rounding.

Productivity and Erodibility

Productivity--Estimated average nonirrigated net revenue from common field crops (corn, soybeans, wheat, sorghum, oats, barley, cotton, and rice) is used as an economic index of soil productivity in this article. This measure is not intended as an estimate of actual revenue from farming each type of soil, because it excludes fixed production costs, but is a simple average of as many of the eight major field crop yields available, and is applied to nonirrigated cropland soils whether these eight crops were actually grown in 1982 or not. Farmers' actual crop rotations would not include all of the crops and would probably be more heavily weighted toward one or two crops. The acreage-weighted average net return to crop production is calculated from the simple average net return at each nonirrigated cropland sample point in the 1982 National Resources Inventory using the expansion factor as the acreage weight. The study used the following formula:

$$NR = \left(\sum_{i=1}^{n} Q_iP_i - C_i\right)/n$$

Where:

- NR = net revenues from crop production at the sample point,
- Q_i = 1982 soil-specific crop yield of the ith crop,
- P_i = 1982 season-average market price per unit of the ith crop,
- C_i = 1982 Farm Enterprise Data System (FEDS) variable production cost of the ith crop,
- n = the number of crops with estimated yield for the soil at the sample point.

Very little consistent information is available on agricultural production costs across multicounty areas. FEDS and university crop budgets generally show either an average or a recommended input use for geographic areas containing a wide variety of different soil types and topographic conditions. These figures do not adequately reflect cost variation due to soil erodibility. Increased costs on erodible soils are uncertain (1, pp. 29-35). Erodible soils that are in an eroded condition may have significantly higher costs than those that are not eroded. Too few studies have collected information on the actual inputs used on particular fields and the resulting outputs to provide comprehensive data (5).

Erodibility--This article uses a measure of inherent soil erodibility from the parameters of the Universal Soil Loss Equation (USLE) contained on each NRI record (2). Numerical limits to the classes are as follows:

Nonerodible = $[RK(LS)]/T \quad 2$;

Moderately erodible:

Managed to erode below T = $2<[RK(LS)]/T <15$ and $A <T$;

Managed to erode above T = $2<[RK(LS)]/T <15$ and $A \geq T$;

Highly erodible = $[RK(LS)]/T \geq 15$;

Wind-erodible = $W > T$;

Where:

- R = the rainfall erosion index of the USLE
- K = the soil erodibility index of the USLE
- LS = the topographic factor of the USLE
- T = the soil loss tolerance value of the USLE
- A = estimated rate of sheet and rill erosion using the USLE
- W = estimated rate of wind erosion using the wind erosion equation (WEE)

Wind-erodible land was segregated in a separate class because parameters of the wind erosion predictive equation were not available to calculate the appropriate wind erodibility index (4).

A limit of 8 on the erodibility index (EI) for both sheet and rill and wind erosion is used in the conservation compliance and sodbuster provisions of the Food Security Act of 1985. The class limit of 15 for highly erodible land in this study focuses on the most highly erodible cropland and is better suited to the objective of this research. Since RKLS/T equals the inverse of the cropping and practice factors (1/CP), a class limit of 15 implies management changes consistent with reducing the combined CP factor below 0.06 to achieve tolerable soil loss, an extremely difficult objective limit fits the concept of highly erodible land as land that cannot meet soil loss tolerances except through conversion to permanent cover.

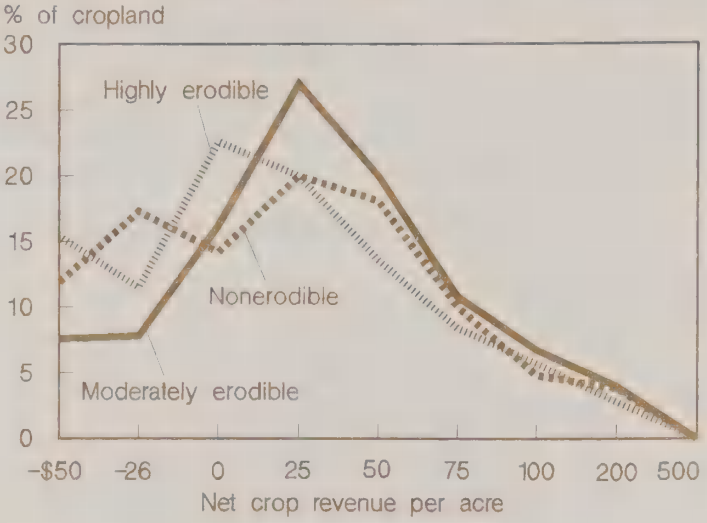
The RKLS/T limit of 8 used in implementing the Food Security Act of 1985 only implies reduction of CP below 0.125 to achieve tolerable soil loss, well within the range of continuous row crop systems using conservation tillage technology. The limit of 8 was an expedient choice to maximize the cropland acreage subject to conservation provisions, but that does not require conversion out of use for annual crop production.

this analysis (EI greater than 15) will have to be retired from production in order to meet compliance requirements, although much of the highly erodible land defined in regulations implementing conservation compliance (EI between 8 and 15) will continue in crop production with the use of conservation tillage or other conservation practices.

Rental bid caps on highly productive, highly erodible land may have to be increased to induce owners to enroll such land in the CRP. Some highly productive acreage of highly erodible land will only be bid into the CRP if rental bid caps are as high as expected returns from continued cropping (See figure). Variable bid caps in the geographic bidding pools partially account for differing productivity of highly erodible land, to the extent that highly productive, highly erodible land is geographically concentrated. However, analysis of State average bid caps and average potential net returns on nonirrigated highly erodible land have a low correlation coefficient.

Conservation compliance provisions may impose high opportunity costs on farmers with highly productive, highly

Distribution of Net Crop Revenue from Nonirrigated Cropland, 1982



erodible land that require permanent retirement to meet erosion goals. These costs may drive some farmers out of farm programs or require less stringent erosion standards to avoid undue economic hardship. Higher cost, however, is insufficient reason to exclude some highly erodible land from conservation compliance or the CRP. Benefits of reducing erosion on highly productive, highly erodible land may more than justify higher costs for treating or retiring such land.

Attempts to combine both short-term and long-term productivity characteristics lead to measures with little precision for resource assessment and policy analysis. Combining physical limitations that have both long- and short-term physical and economic consequences with measures of soil productivity compounds the problem. Classifications of economically marginal land are always sensitive to changes in relative prices of commodities being considered, technological developments that favor some land more than others, and changes in the cost of production inputs. Better information for policy and program decisions affecting both physically and economically marginal land would be of great value in determining the potential net economic benefits of erosion control programs. No single classification system can identify both physically and economically marginal land equally well. Both kinds of information are needed by policy makers.

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PROGRAM CROP PRODUCTION AND FEDERAL IRRIGATION WATER

by
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The Federal Government, operating through the Bureau of Reclamation in the Department of the Interior, has provided nonreimbursable funds for development of rivers and streams in the American West to supply water for agriculture. Irrigated agriculture producers, consequently, pay a price for bureau water below the actual cost of supplying it.

A portion of the water helps produce program crops--barley, corn, cotton, oats, rice, sorghum, and wheat. Concurrently, the Federal Government supports prices of these crops and incomes of farmers who produce them through programs administered by USDA.

On lands receiving irrigation water from the Bureau of Reclamation, critics contend that Federal policies coalesce to create three issues of concern: consistency, as USDA programs offer incentives to limit acreage and production of program crops while the Federal water program, by subsidizing water use, encourages expansion of irrigated acreage and production (1); fairness, as agricultural producers without bureau water must compete with recipients of bureau water; and a Federal budget issue, as combined Federal expenditures on the two programs remain unassessed.

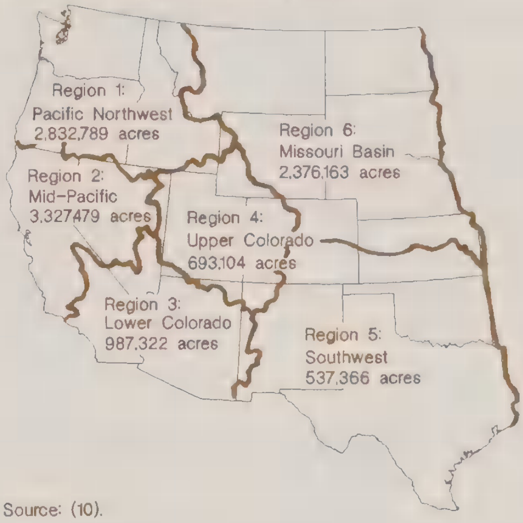
This article provides information on the operations of the two Federal programs and addresses the budget issue by estimating 1986 Federal irrigation water expenditures and 1980-86 farm program payments received by agricultural producers who irrigate program crops with bureau water.

Operations of the Bureau of Reclamation

The Bureau of Reclamation operates in six regional divisions that follow watershed boundaries of the major river systems in the 17 Western States (see figure). To accomplish its original mission--promoting permanent settlement of Western lands through establishment of irrigated agriculture--the bureau constructed 355 water storage reservoirs, 254 diversion dams, and thousands of miles of transportation canals, pipelines, tunnels, and laterals (10). This infrastructure of water-resource development concentrates on irrigation facilities and hydroelectric power facilities (rather than municipal and industrial facilities), with some of the hydropower also serving irrigation.

Total harvested, irrigated area in lands served by the bureau in 1986 was 10.09 million acres (table 1), and total bureau water delivered to farms was 27.21 million acre-feet

Bureau of Reclamation Regional Boundaries and Irrigated Acres, 1986



Source: (10).

(10). Of the total area, 4.18 million acres (41 percent) received full water service, 5.69 million acres (57 percent) received supplemental water service, and 0.22 million acres (2 percent) received temporary water service (10). Full water service means that an irrigator relies completely on the bureau for water supply, while supplemental means that an irrigator has additional water sources available. Temporary water service occurs simply as a temporary arrangement. The bureau provided irrigation water to 92,973 full-time farms and 57,332 part-time farms in 1986 (10).

Lands served by the Bureau of Reclamation, like Western irrigated agriculture in general, produce a variety of crops. Bureau-served lands devote a large share of acreage to fruits, nuts, and vegetables, which are not the subject of Government support programs. At the same time, 3.38 million acres of program crops--a third of bureau acreage--are grown on these irrigated lands. The relatively large amount of irrigated alfalfa, other hay, pastureland, and other forage also is notable, accounting for 3.57 million bureau-served acres. High prices for dairy products resulting from the Federal dairy program may induce some of this feed production.

That the bureau serves over one-fourth of irrigated acreage in the 17 Western States reflects the important historical role of the Federal Government in irrigation development (table 1). Of Western irrigated vegetable acreage, four-fifths receives bureau water; much of this occurs in central and southern California's productive farmland. The share of national acreage in bureau-served lands is small, however, comprising only 2.3 percent of total cropland and

Table 1.--Bureau of Reclamation irrigated acres and production, 1986

Commodity	Crop acres					Crop production			
	Bureau harvested irrigated acres	Irrigated acres in 17 Western States 1/	Bureau percent of Western irrigated acres by crop	National harvested crop acres	Bureau percent of national acres by crop	Production units	Bureau crop production	National crop production 2/	Bureau percent of national production by crop
	1,000 acres		Percent	1,000 acres	Percent		1,000 production units		Percent
Program crops									
Barley	574.1	1,722.0	33.3	12,007.0	4.8	Bu.	46,510.9	610,497.0	7.6
Corn	916.2	6,795.7	13.5	69,189.0	1.3	Bu.	121,125.3	8,252,834.0	1.5
Upland cotton	679.1	-- 3/	-- 3/	8,357.3	8.1	Bale	1,499.3	9,525.2	15.7
Am. Pima cotton	44.8	-- 3/	-- 3/	111.1	40.3	Bale	70.6	205.9	34.3
Oats	72.8	-- 3/	-- 3/	6,870.0	1.1	Bu.	5,487.6	384,546.0	1.4
Rice	214.4	742.7	28.9	2,380.0	9.0	Cwt	15,469.7	134,416.0	11.5
Sorghum	89.1	1,589.8	5.6	13,904.0	0.6	Bu.	8,206.3	941,634.0	0.9
Wheat	784.7	3,913.9	20.0	60,688.0	1.3	Bu.	64,876.6	2,086,780.0	3.1
Nonprogram crops									
Alfalfa and other hay	2,365.6	8,008.0	29.5	62,274.0	3.8	Ton	11,393.2	155,271.0	7.3
Pasture land and other forage	1,200.8	-- 3/	-- 3/	-- 3/	-- 3/	Aum	-- 4/	-- 4/	-- 3/
Fruits and nuts	994.3	-- 3/	-- 3/	3,422.5	29.1	-- 4/	-- 4/	-- 4/	-- 3/
Vegetables	962.1	1,218.1	79.0	2,291.3	42.0	-- 4/	-- 4/	-- 4/	-- 3/
Other	1,187.5	-- 3/	-- 3/	-- 3/	-- 3/	-- 4/	-- 4/	-- 4/	-- 3/
TOTAL	10,085.5	38,157.1	26.4	447,783.0 5/	2.3				

1/ Figures are 1984 estimates from (9). These figures are the most recent estimates of irrigated acreage in the 17 Western States. 2/ 1986 preliminary estimates. 3/ Not available. 4/ No common production units for these crops. 5/ Figure includes cropland used for crops and pasture but does not include grassland pasture.

Sources: (7,9,10)

less than 10 percent of national acreage for most crops. This reflects the immense scale of American agriculture; it does not suggest that bureau-served lands are insignificant.

Note finally that, for each crop except pima cotton, the bureau's share of national production is larger than its share of national acreage (table 1). This reflects the higher yields produced by irrigation.

Irrigation Water Subsidies

The Federal reclamation program, initiated in 1902 with the National Reclamation Act and perpetuated with subsequent amendments and statutes, was designed to promote permanent Western settlement by financing irrigation projects. More than simply establishing an agricultural base, however, provisions in the program geared reclamation to the working farmer and the family farm. These included the original 160-acre limitation, which stated that reclamation water could not be applied to more than 160 acres under sole ownership, and a later provision that priced Federal irrigation water at a farmer's "ability to pay." The ability-to-pay provision determined a project's water price by evaluating the income potential of irrigating the project's land. By doing so, water price was set independently of a project's construction costs.

The Federal irrigation water subsidy occurs because Federal expenditures on water supply are not completely reimbursed by contractual water prices. Two components of the price-setting procedure result in subsidy: 1) setting contractual water price on the irrigators' ability to pay rather than on the actual water supply cost, and 2) funding water project construction costs without charging interest on the loaned funds. The second component created a financing subsidy because the Government, at the time of construction, paid construction costs allocated to irrigation while the irrigators repaid these without interest over a long repayment period.

Reclamation contracts governing the repayment terms of water project construction costs allocated to irrigation generally apply for 40 years, thereby assuring predictable, long-term water deliveries at the contractual water price. Because of the reclamation program's long-term stability, many reclamation subsidies have been capitalized, wholly or partially, into the value of land receiving reclamation water (4). The market price of the land, reflecting the financial value of Federal support and the availability of reclamation water, greatly exceeds that of nonirrigated land in the West. Consequently, the original owner of the land receives some portion of the financial value of the reclamation subsidy. Subsequent owners, when land has been exchanged, already have paid for some or all of the value of Federal support, having agreed to a price that reflects the benefit of some portion of the reclamation subsidy.

The possibility of the reclamation subsidy already being appropriated when the original owner has sold the land should be recognized: information on subsidy appropriation could influence the fairness of policy changes affecting contractual water prices. LeVeen and Goldman (4) concluded

Table 2.--Contract prices, full-cost prices, and subsidy rates for water delivered from selected Bureau of Reclamation projects

Project, State	Contract price	Full-cost price	Subsidy rate
		$/acre	
Arnold, OR	1.14	1.74	0.60
Mann Creek, ID	3.99	60.52	56.53
Yakima, WA	3.44	10.85	7.41
Feather River Unit (CVP 1/, 3/), CA	3.99	37.13	33.14
Cow Creek Unit (CVP 1/, 3/), CA	19.76	182.51	162.75
Boulder Canyon, AZ-CA-NV	11.95	18.50	6.55
Gila, AZ	8.35	31.37	23.02
Collbran, CO	0.98	21.50	20.52
Weber Basin, UT	21.27	80.60	59.33
Middle Rio Grande, NM	4.15	21.05	16.90
W.C. Austin, OK	1.10	1.90	0.80
Huntley, MT	1.17	2.79	1.62
Ainsworth Unit (PSMBP 2/), NE	2.43	57.79	55.36
Hanover-Bluff Unit (PSMBP 2/), ND	2.51	90.83	88.32
Kansas-Bostwick Unit (PSMBP 2/), KS	9.45	80.95	71.50
Shadehill Unit (PSMBP 2/), SD	2.25	45.84	43.59
Shoshone, MT-WY	1.55	8.36	6.81

1/ "CVP" represents Central Valley Project. 2/ "PSMBP" represents Pick-Sloan Missouri Basin Project. 3/ The original prices for CVP units are expressed in dollars per acre-foot. Figures are converted to dollars per acre using average water application rates for the CVP units from (10).

Source: (11)

that this fairness issue continually poses a dilemma when considering reform of reclamation policy, writing that, "Imposition of new regulations which force the sale of land at pre-project value would impose significant and uncompensated welfare losses on many who purchased the land at prices which include project benefits." (p. 933). However, little specific information exists about the fairness issue.

Reclamation water prices and subsidy rates vary from project to project. They depend primarily on the difference between the actual construction and financing costs of a project and the estimated profitability of irrigation on the lands served by it. Table 2 contains subsidy rates that are calculated as the difference between contractual water prices and full-cost prices for 17 projects that are representative of 143 total bureau projects (11). The subsidy rates range from a low of $0.60 per acre in Arnold Project in Oregon to $162.75 per acre in the Cow Creek Unit of Central Valley Project in California. Information on full-cost prices, and thus the reported subsidy rates, is taken directly from a report by the U.S. Department of the Interior (11), which used a definition of full-cost price from Section 203(a) of the Reclamation Reform Act of 1982. The definition does not include past subsidies created by the ability-to-pay provision, which allocated too few costs to irrigation. Table 2's subsidy rates, consequently, provide a lower bound estimate of actual Federal expenditure rates on irrigation water that have not been reimbursed.

Agricultural Commodity Payments

Federal Government intervention in agricultural markets, initiated in the 1930's, accomplishes three objectives: protection of agricultural producers from low market prices, accomplished by setting a price floor for program crops; support of farm income, accomplished by setting a target price for program crops; and national food security, accomplished by Government ownership of commodity reserves and by programs to guide planted acreage to maintain desired levels of reserves (3).

All three may result in payments or subsidies to agricultural producers, depending on the controlling legislation at the time and annual market prices. Beginning in the 1970's, Congress limited total program payments to individuals, with the current limit set at $50,000 per year.

Participation in commodity programs is voluntary, and compliance with certain land set-aside provisions is often the only requirement. In contrast with the Federal reclamation program's lengthy contracts, commodity programs establish an annual, renewable contract between agricultural producers and the Federal Government. Legislation governing general features of commodity programs applies to 4- or 5-year periods.[1] These characteristics may make the provisions of commodity programs, relative to the reclamation program, easier to amend and adapt to current situations.

Participation in a commodity program qualifies a producer for three forms of USDA payments: price support, income support, and paid land diversion (2). The price support system operates through nonrecourse loans that USDA makes to producers to help with planting costs. Loans are made at a level termed the loan rate, which the Secretary of Agriculture sets prior to the growing season. Producers can repay the loans with either money or forfeited commodities. When the actual market price exceeds the loan rate plus interest charges on the loan, a producer will repay with money. No Government subsidy in the form of price support occurs in this case. When the loan rate exceeds the market price, the program sets a price floor at the loan rate. The producer will repay with forfeited commodities, and the Government has no recourse but to accept this form of repayment.

[1] The Food and Agriculture Act of 1977 guided agricultural policy through 1981, the Agriculture and Food Act of 1981 guided policy between 1982 and 1985, and the Food Security Act of 1985 guides policy through 1990. Within the legislation's general structure, the Secretary of Agriculture defines specific features of commodity programs annually to adjust them to current circumstances.

Table 3.--Prices and payment rates by commodity for representative years: 1980, 1984, and 1985

Commodity	1980						1984						1985					
	Prices			Payment rates			Prices			Payment rates			Prices			Payment rates		
	Target price	Loan rate	Market price	DPR 1/	PSL 2/	PLD 3/	Target price	Loan rate	Market price	DPR	PSL	PLD	Target price	Loan rate	Market price	DPR	PSL	PLD
Barley ($/bu.)	2.55	1.83	2.91	0	0	NP 4/	2.60	2.08	2.29	0.31	0	NP	2.60	2.08	1.98	0.52	0.10	NP
Corn ($/bu.)	2.35	2.25	3.27	0	0	NP	3.03	2.55	2.63	0.40	0	NP	3.03	2.55	2.23	0.48	0.32	NP
Cotton ($/lb.)	0.58	0.48	0.76	0	0	NP	0.81	0.55	0.58	0.24	0	NP	0.81	0.57	0.56	0.24	0.01	0.30
Oats ($/bu.)	1.23	1.16	1.82	0	0	[illegible]	1.60	1.31	1.67	0	0	NP	1.60	1.31	1.23	0.29	0.08	NP
Rice ($/cwt)	9.49	7.12	12.00	0	0	NP	11.90	8.00	8.04	3.86	0	[illegible]	11.90	8.00	6.53	3.90	1.47	3.50
Sorghum ($/bu.)	2.50	2.14	3.02	[illegible]	0	NP	2.88	2.42	2.32	0.46	0.1	NP	2.88	2.42	1.93	0.46	0.49	[illegible]
Wheat ($/bu.)	3.63	3.00	3.96	0	0	NP	4.38	3.30	3.39	0.99	0	2.70	4.38	3.30	3.08	1.08	0.22	2.70

1/ DPR is the deficiency payment rate, calculated [illegible] the target price minus the higher of either the market price or the pre-set price floor; it equals zero when the market price exceeds the target price. This paper calculates DPR using crop prices from (8), which explains the slight deviation from official DPR's. 2/ PSL is the net subsidy rate of price support loans, calculated as the loan rate minus the market price whenever the loan rate exceeds the market price; it equals zero when market price exceeds the loan rate. 3/ PLD is the payment rate for voluntary paid land diversion. 4/ NP = No program defined for the commodity in the year.

Source: (5,8)

Repayment in forfeited commodities creates an effective payment, or subsidy, to producers at [illegible] rate defined by the difference between the loan rate and the market price. The Government effectively pays for the crop at the loan rate yet receives in-kind payment whose value is determined by the (lower) market price. This article defines this subsidy rate as the price-support loan rate (PSL).

The Food Security Act of 1985 modifies the nonrecourse loan program for upland cotton and rice (2). Producers can repay loans for upland cotton and rice at an adjusted world market price. This provides producers the incentive to sell these commodities on world markets and repay loans with money rather than forfeiting production to USDA as the form of repayment.

Income support is provided through deficiency payments. Program participants receive payment at [illegible] rate equal to the difference between [illegible] target price and the higher of either the average marketing year price or the loan rate; this is termed the deficiency payment rate (DPR). The Food Security Act of 1985 guides target prices through 1990, with the Secretary of Agriculture setting specific target prices prior to the growing season. When the market price equals or exceeds the target price, the deficiency payment rate will equal zero. In this case, market price is sufficiently high to render income support (and, in fact, price support) unnecessary.[2]

The paid land diversion rate (PLD) defines the payment rate for voluntary land diversion in excess of acreage reduction requirements for a particular crop. It is set before the growing season and exists independently of market prices.

Rates for the three forms of commodity payment vary by commodity and by year. Information from three representative years--1980, 1984, and 1985--illustrates how they vary depending on actual market and target prices and loan rates (table 3).

Target prices were uniformly lower and market prices uniformly higher in 1980 relative to 1984 and 1985. In 1980, market prices exceeded target prices for each commodity, with payment rates for income support and price support consequently equal to zero. In contrast, the 1985 combination of high target prices and depressed market prices resulted in high payment rates for 1985. Compare these also to the 1984 payment rates: the 1984 target prices equaled the 1985, yet 1984 deficiency payment rates were lower and price-support loan rates, generally, were zero because of relatively strong market prices that year.

Provisions for voluntary paid land diversion also varied by year and by crop, with no programs in 1980, diversion payments for wheat in 1984, and diversion payments for upland cotton, rice, and wheat in 1985.

[2] The 1988 drought may create a situation where conventional income and price support programs are not necessary throughout the Nation because market prices are high [illegible] consequence of the drought. Disaster payments, though, may be necessary to supplement farm income in regions where drought conditions severely affect production.

Table 4.--Estimated total agricultural commodity program payments on lands receiving Bureau of Reclamation water, 1980-1985

Commodity	1980	1981	1982	1983 1/	1984	1985
	$ Million (nominal terms)					
Barley	0.0 2/	7.1	10.1	6.4	6.0	16.9
Corn	0.0 2/	0.0 2/	4.1	116.8	23.5	67.9
Upland cotton	0.0 2/	211.4	108.4	229.7	151.6	193.2
Am. Pima cotton	0.0 2/	-- 3/	-- 3/	0.0 2/	1.0	2.3
Oats	0.0 2/	0.0 2/	0.0 2/	0.1	0.0 2/	0.1
Rice	0.0 2/	32.5	42.7	70.2	50.3	82.4
Sorghum	0.0 2/	2.3	0.7	6.2	1.5	3.0
Wheat	0.0 2/	10.0	22.3	116.6	65.0	80.6
Total	0.0	263.3	188.3	546.0	298.9	446.5

1/ 1983 estimates include payments from Payment-in-Kind (PIK) program. 2/ No program payments made for this crop in this year because market price exceeded target price. 3/ No program for this crop in this year.

Sources: (5,7,8,10)

The Food Security Act of 1985 seeks to give the agricultural economy a market orientation by linking target prices, price floors, and historical market prices more closely (2). Its provisions include: target prices that decline between 1986 and 1990 so that deficiency payment rates should decline; lower loan rates so that Government-owned reserves should decline; and high mandatory acreage reduction and the Conservation Reserve Program (a provision to remove additional acreage from production for a 10-year period) so that paid land diversion may not be necessary.

Estimated Federal Payments to Producers Receiving Bureau Water

Agricultural Commodity Payments, 1980-85

Estimates of annual total commodity payments received by agricultural producers who used bureau water vary depending on the annual commodity payment rates. During 1980-85, estimated total agricultural payments--from price support payments, income support payments, and paid land diversion--ranged from $0 (in 1980) to $546 million (in 1983) (table 4). Payments peaked in 1983 because of the Payment-in-Kind program (PIK). Total payments in 1985 were higher than in 1984 because the 1985 payment rates were uniformly higher (table 3). Upland cotton producers received a large share of the total each year, including 80 percent of the 1981 total. This was due to the relatively large irrigated acreage of upland cotton in bureau-served lands (table 1), along with upland cotton's relatively high target prices and low market prices during the period (table 3). Wheat, corn, and rice producers also received significant shares of the total payments during most of the period.

Agricultural Commodity Payments and Irrigation Water Subsidies, 1986

Critics of the Federal programs in bureau regions contend that the "double subsidy" of agricultural producers--combined commodity payments and water subsidies--creates a situation of excessive Federal aid.[3] An accurate accounting of the apparent double subsidy must recognize two facts: first, only a portion of bureau-served, program-crop producers participate in commodity programs in any given year, and, second, only a portion of bureau projects still receive Federal irrigation water subsidies according to the definition of subsidy used by the bureau (11).

The intersection of these two groups constitute the class of bureau-served lands receiving a double subsidy. For example, estimated total commodity payments made to bureau-served lands was $495.77 million in 1986 (table 5). After removing the unsubsidized bureau projects, commodity payments were reduced to $378.79 million. Similarly, 1986 irrigation water subsidies for program crop production decreased from $84.97 million to $66.49 million when including only the acreage that participated in commodity programs (table 5).

Table 5.--Commodity payments and irrigation water subsidies, 1986

	All bureau lands	Bureau lands participating in both programs
	$ Million	
Commodity payments	495.77	378.79
Water subsidies for program crop production	84.97	66.49

Sources: (5,7,8,10,11)

[3] Supporters of the Irrigation Subsidy Reform Act (H.R. 1443) take this position. The proposed legislation, under consideration in the U.S. House of Representatives, would charge full-cost water prices when bureau water irrigates program crops. The current article does not take the position that a double subsidy inherently should be scrutinized. A single company, farm, or family frequently receives two or more Federal subsidies as incentive to achieve social objectives. A family, for example, can receive several subsidies through the Federal tax code: for home ownership, municipal bond ownership, charitable contributions, and dependent children.

Table 6.--Estimated commodity program payments and irrigation water subsidies to lands participating in both programs on Bureau of Reclamation lands, 1986

Commodity	Pacific Northwest		Mid-Pacific		Lower Colorado		Upper Colorado		Southwest		Missouri Basin		TOTAL BY CROP	
	CP 1/	IWS 2/	CP	IWS	CP	IWS	CP	IWS	CP	IWS	CP	IWS	CP	IWS
							$ Million							
Barley	5.55	0.82	1.10	1.64	0.02	0.01	0.67	0.37	0.01	-- 8/	4.77	1.39	12.48	4.22
Corn	6.64	3.21	3.52	1.62	0.02	-- 4/	2.41	0.28	0.29	0.04	56.21	12.91	69.09	18.07
Upland cotton	-- 3/	-- 3/	92.49	26.31	8.98	0.36	-- 3/	-- 3/	5.22	0.03	-- 3/	-- 3/	106.69	26.70
Am. Pima cotton	-- 3/	-- 3/	0.01	0.01	-- 9/	-- 5/	-- 3/	-- 3/	-- 9/	-- 5/	-- 3/	-- 3/	0.01	0.01
Oats	0.12	0.14	-- 6/	0.08	-- 6/	-- 4/	0.02	0.04	-- 4/	-- 4/	0.09	0.09	0.23	0.36
Rice	-- 3/	-- 3/	108.00	3.22	-- 3/	-- 3/	-- 3/	-- 3/	-- 3/	-- 3/	-- 3/	-- 3/	108.00	3.22
Sorghum	0.01	-- 4/	0.87	0.29	0.03	-- 8/	-- 9/	-- 6/	0.66	0.06	2.64	1.61	4.21	1.96
Wheat 7/	54.12	5.29	8.16	3.56	8.58	0.16	1.33	0.50	1.31	0.07	5.40	2.36	78.09	11.94
TOTAL BY REGION	66.44	9.47	214.15	36.74	17.63	0.54	4.43	1.19	7.49	0.20	69.11	18.36	378.79	66.49

1/ CP represents estimated total commodity payments for program crops in bureau regions. 2/ IWS represents estimated irrigation water subsidies received by producers participating in USDA commodity programs on bureau lands. This figure is the difference between the potential full cost revenue and normal contractual revenues for program crops in these regions using price information from (11). 3/ Not applicable. Crop is not grown in this bureau region. 4/ Negligible. 5/ No subsidy exists for the crop grown in this bureau region because the project in which it is grown has fulfilled its repayment obligation to the Federal Government. 6/ No commodity payment is made for this crop because market price exceeds target price in this bureau region. 7/ Wheat payment estimates include paid land diversion payments but do not include Payment-in-Kind (PIK) estimates. PIK estimates would be minor because PIK provisions in the Food Security Act of 1985 are a minor component of price and income supports. 8/ The value of the estimated subsidy is less than $5,000. 9/ No subsidy occurs for this crop because the bureau project in which it is grown does not receive an irrigation subsidy.

Sources: (5,7,8,10,11)

Note that, although commodity payments greatly exceeded water subsidies in 1986, this may not be true in general because of the fluctuation in commodity payments (table 4). Irrigation water subsidies experience less dramatic changes because long-term contracts establish the basic water subsidy rates. In 1980-86, commodity payments exceeded water subsidies in every year but 1980.

Table 6 disaggregates, by program crop and by bureau region, the information in table 5 on bureau lands receiving a double subsidy. Among crops, rice ($108.0 million), upland cotton ($106.69 million), wheat ($78.09 million), and corn ($69.09 million) received the largest commodity subsidies in 1986. Upland cotton ($26.7 million), corn ($18.07 million), and wheat ($11.94 million) received the largest water subsidies. Several large crop subsidies were concentrated in single regions: upland cotton and rice in the Mid-Pacific, corn in the Missouri Basin, and wheat in the Pacific Northwest.

Commodity Payments and Water Subsidies Per Acre, 1986

Converting commodity payments and irrigation water subsidies to a per-acre basis provides a final perspective on the programs. Information on per-acre subsidies eliminates the influence of acreage as a determinant of crop and regional totals: the large bureau-served acreage in the Mid-Pacific region, for example, explains partially the large subsidies there (tables 1 and 6). Consider the per-acre commodity payments for corn and wheat (table 7). For corn, these ranged from $73 in the Lower Colorado region to $201 in the Missouri Basin region. Higher corn yields and lower market prices for corn in the Missouri Basin, and the reciprocal situation in the Lower Colorado, explain this result. Wheat exhibits a smaller range of payments per acre, indicating less variation in regional wheat yields and prices.

Table 7.--Estimated per acre program crop payments and irrigation water subsidies on Bureau of Reclamation lands in 1986

Region	Corn		Wheat	
	CP 1/	IWS 2/	CP	IWS
		$/acre		
Pacific Northwest	73	35	188	18
Mid-Pacific	92	43	130	57
Lower Colorado	73	6	158	3
Upper Colorado	163	19	111	42
Southwest	108	2	112	6
Missouri Basin	201	46	95	41
Weighted Average	163	43	116	25

1/ CP represents estimated per acre commodity payments for corn and wheat in bureau regions. 2/ IWS represents estimated per acre irrigation water subsidies on bureau lands served by subsidized water.

Sources: (5,7,8,10,11)

Regional differences in water subsidy rates explain the variation in crop-specific per-acre water subsidies. Corn and wheat subsidies again represent the regional patterns (table 7). Projects in the Mid-Pacific and Missouri Basin regions are relatively newer and have more years remaining before they complete their contractual payments. Their per-acre water subsidies are relatively high. Projects in the Southwest and Lower Colorado regions are relatively older and tend to have relatively lower per acre water subsidies.

Conclusion

This article assesses the magnitude of Federal expenditures on commodity payments and irrigation water subsidies

made to agricultural producers who irrigate with Bureau of Reclamation water. Estimates of annual agricultural commodity payments range from $0 to $546 million during 1980-85. In 1986, the estimate of commodity payments is $496 million, while the estimate of Federal irrigation water subsidies for program crop production is $85 million.

A particular concern is the "double subsidy"--the amount of subsidy received by producers who, in the same year, participated in commodity programs and received irrigation water from a bureau project that continues to be subsidized. In 1986, this class of producers received an estimated $379 million in commodity payments (of the $496 million total) and $66 million in irrigation water subsidies (of the $85 million total).

Proposed new policies that would change the existing situation of program crop production with bureau water include altering reclamation water prices, either immediately or when current contracts expire, and excluding recipients of bureau water from participation in commodity programs.

Any policy changes directed at agricultural producers in bureau-served lands must consider several qualifications. First, the issue of whether the water subsidy is either real or only apparent to the current generation of producers with bureau contracts affects the fairness of any new policy that would alter reclamation water prices. Perhaps any new policy should allow producers whose subsidy was appropriated by an earlier generation of landowners to demonstrate this with the financial record of the farm pur-

Estimating Producer Subsidies from Agricultural Commodity Programs and the Federal Irrigation Water Program

Tables 4 through 7 estimate producer subsidies from agricultural commodity programs and the irrigation water program. With commodity programs, price- and income-support subsidies are computed, for each commodity and each year, as the product of: 1) the deficiency payment rates (DPR) or price-support loan payment rates (PSL) like those in table 3, 2) bureau-wide production of the commodity, and 3) the national average rate of participation in the particular commodity program. Subsidies for paid land diversion are computed, for each commodity and each year, as the product of: 1) the PLD subsidy rates as in table 3, 2) estimated bureau base acreage of the commodity, 3) average yield of the commodity in bureau-served lands, and 4) the national average rate of participation in the land diversion programs relative to national base acreage.

Subsidy estimates for 1983 include PIK subsidies in addition to conventional payments for income support, price support, and paid land diversion programs. PIK subsidy estimates are made by multiplying an estimate (based on PIK participation rates and estimated bureau base acreages) of in-kind transfers of program commodities by the 1983 market prices of the commodities.

In tables 5 and 6, commodity estimates are made as in table 4 with three exceptions. One, to encourage exports, the Food Security of 1985 defines new price-support subsidy rates for upland cotton and rice as the difference between the price floor and an adjusted world market price (instead of U.S. average price). Two, to obtain more accurate estimates of the regional subsidies, the computations use specific participation rates and market prices for each of the 17 Western States in place of national averages. For example, to estimate income support subsidies for barley in the Pacific Northwest region, the product of: 1) barley production in Montana's Pacific Northwest projects, 2) a deficiency payment rate composed of barley's target price minus Montana's market price for barley, and 3) Montana's participation rate in the barley program, is added to similar calculations for Idaho, Oregon, and Washington to compute the regional total. A similar calculation is made for price support subsidies and land diversion payments, for each crop and each region, to produce the estimates in table 6. And three, only lands in bureau projects that are subsidized, according to the definition in a report by the U.S. Department of the Interior (11), contribute to the payment estimates in table 6. Table 5 contains the same calculations simply aggregated to bureau totals and, in addition, estimates commodity payments in both subsidized and unsubsidized bureau projects.

The agricultural subsidy figures rely on three assumptions that make the figures estimates rather than actual subsidies. The assumptions, which are required to replace unavailable information, include: agricultural producers receiving Bureau of Reclamation water participate in agricultural crop programs at the same rate as the national average participation rate; the ratio of bureau irrigated, harvested acreage to program base acreage [defined in (2)] equals the national average ratio of harvested acreage to program base acreage; and actual crop yields on bureau lands replace program yields, which are set from historical yield information from individual farms (2).

The irrigation water subsidies in table 5 and 6 are calculated for each program crop using water subsidy rates [from (11)] and crop-specific irrigated acreage for each project within a bureau region, then summed over projects in the region to compute the regional total. For example, multiplication of irrigated acreage of wheat participating in the wheat commodity program in the Yakima project in Washington by the project's water subsidy rate per acre (table 2) yields the project's estimated subsidy of water used in wheat production. Repeating this for wheat in each of the region's projects, then summing, yields the Pacific Northwest estimated subsidy of water used in wheat production in table 6. Table 5 contains the same calculations simply aggregated to bureau totals. The irrigation water subsidy estimates in tables 5 and 6 assume that, within a bureau project, water application rates are constant across crops.

Note that tables 4-6 estimate total producer subsidies, not total program costs to the Federal Government. Total agricultural program costs include crop reserve storage and administrative costs. Water program costs include administrative costs.

Table 7 expresses commodity payments and water subsidies from table 6 on a per-acre basis for corn and wheat. Estimated corn payments and wheat payments are divided by estimated acreage participating in corn and wheat programs, respectively, for each bureau region. Estimated water subsidies are divided by irrigated, harvested corn acreage and wheat acreage within bureau projects receiving subsidies.

chase. Such evidence might exclude them from a new policy.

Second, this article offers no insight into the effect of a new policy. The calculations use historical information to estimate previous subsidy levels. They do not project changes in agricultural production, cropping pattern, water use, or subsidy levels that certainly would follow from a new policy.

Third, within the next few years, agricultural policies under consideration may affect the importance of the topic of program crop production and Federal irrigation water. For example, the Food Security Act of 1985 gives the agricultural economy a market orientation by reducing commodity program payment rates. The next major farm legislation, which will take effect in 1991, could continue to reduce payment rates. Alternatively, it could either lock in 1990 payment rates into the 1991 legislation or dramatically redirect farm programs. The direction chosen will affect the importance of Federal support levels as a policy issue.

On a related front, current international trade negotiations proceeding under the General Agreement on Tariffs and Trade also are addressing the topic of agricultural subsidies, for both agricultural products and inputs. A multilateral agreement to reduce or remove subsidies may occur between the United States and its trading partners. These arenas of agricultural policy may influence the need to address specifically the topic of program crop production using Federal irrigation water.

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